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Construction Methods

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March, 1935

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IN ROAD BUILDING

By J. L. Harrison

Senior Highway Engineer, U. S. Bureau of Public Roads, Washington, D. C.

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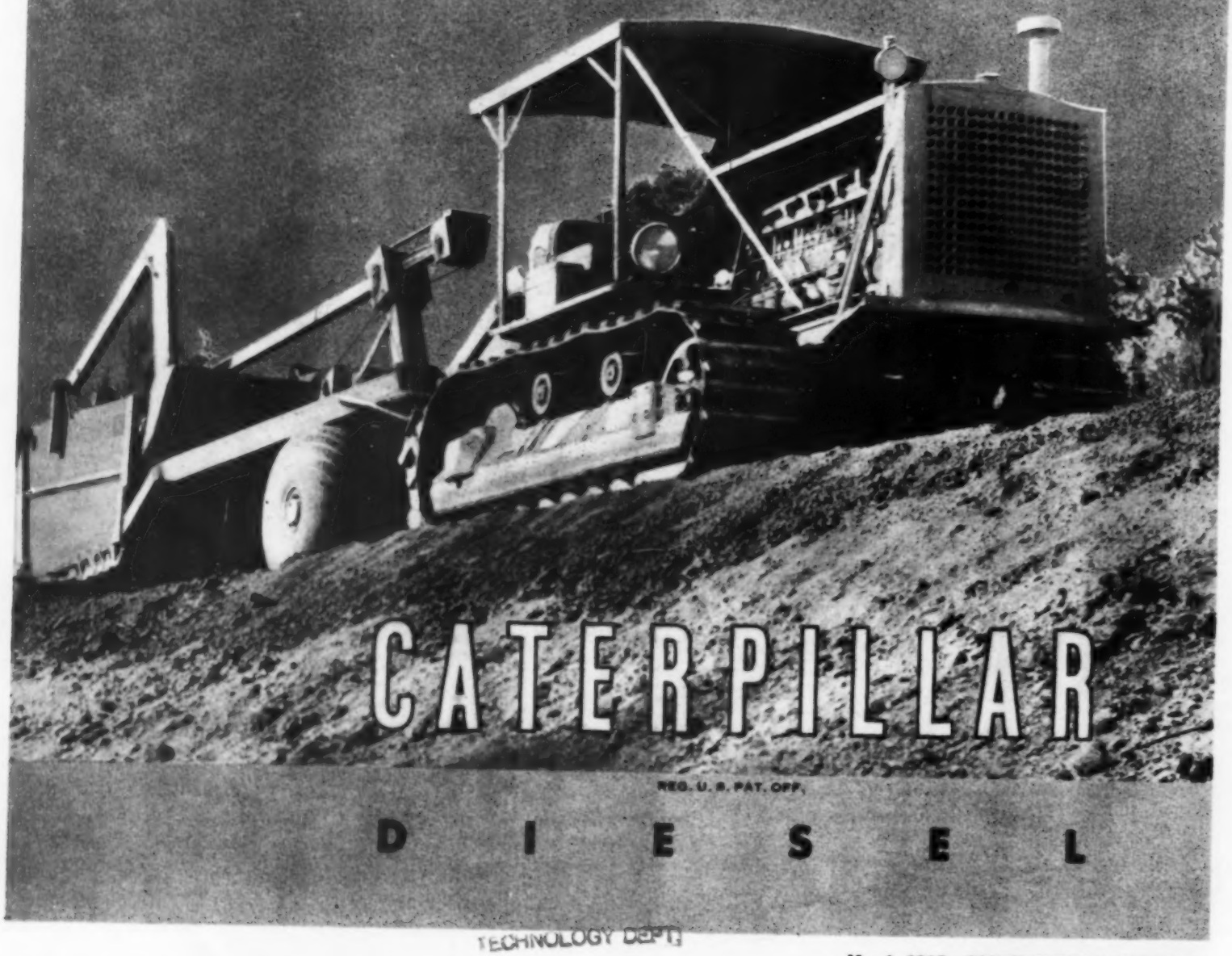

TECHNOLOGY DEPT.

Construction Methods

McGraw-Hill Publishing Company, Inc.,
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ROBERT K. TOMLIN, Editor

MARCH, 1935

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Notes From the A.G.C. Convention

● Discussion at the recent annual convention of the Associated General Contractors of America in Washington, D. C., indicated clearly those problems which are of major concern to the industry under present-day conditions.

Against 30-Hour Week

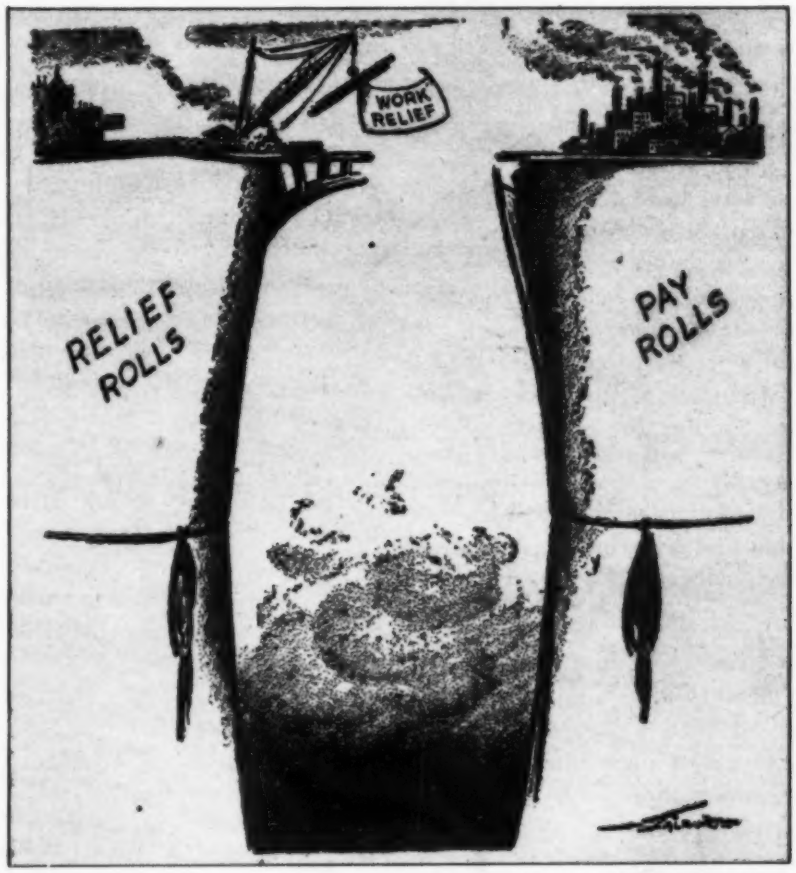
● Experience with the 30-hour week has led to a general condemnation by contractors of this restriction of working time as applied to construction projects. Construction, by its very nature, must be carried on in the open—not under roof, as is the case with the majority of industrial operations and, consequently, is interfered with by weather and climatic conditions which prevent continuous employment. Loss of time on account of rain and cold weather deplete the contents of the worker's pay envelope to a point where his compensation is inadequate for the maintenance of a decent standard of living. The A.G.C. members feel that a 40-hour week is the least that can insure orderly conduct of construction work and adequate compensation for their men.

Compulsory Selection of Workers

● Another thorn in the side of general contractors is the compulsory selection of workers from local relief lists, as required by PWA regulations. This restriction makes difficult, if not impossible, the organization and direction of an efficient working force, causes an unreasonably high turnover in personnel and is responsible for costly repairs to equipment damaged by incompetent operators. The association urged an amendment of PWA regulations to the end that on all projects classified as heavy construction, highway construction, irrigation and all work involving the use of expensive mechanical equipment contractors be permitted to select their skilled and intermediate labor from whatever source they may elect.

Zone Wage Rates

● Existing zone wage rates, in operation for more than a year, instead of stabilizing labor conditions have tended to upset the pre-existing economic balance of the several communities, according to A.G.C. spokesmen. The inequality of price scales of communities within these zones has created "barren areas" where private construction can not proceed and where communities can not afford to avail themselves of federal funds offered because the zone wage rates have set a basis of construction cost beyond the ability of the local financial structure to support. The association recommends that all governmental agencies having to do with predetermination of wages be decentralized and that local conditions be taken into consideration in all such predeterminations.



Talburt, in Scripps-Howard Newspapers

The Way to Bridge the Gap

Contracts, Instead of Day Labor

● To discourage the use of day labor on the proposed federal work relief program advocated by the President the A.G.C. offers the following recommendation: "Wherever possible in the planning and execution of such programs full advantage should be taken of the facilities of private enterprise."

A Questionnaire That Should Be Answered

● Accompanied by a letter of explanation from the Construction Code Authority, the first statistical questionnaire requesting employment and payroll figures is being mailed to 150,000 registered employers of the construction industry, of whom 23,000 are general contractors. The form of the questionnaire has been kept simple so that contractors will not be unduly burdened in supplying this highly important information. It asks for the number of employees who have worked any part of a one week's period ended nearest to Jan. 15 and the total amount of payroll and the total number of man-hours for the four-week period ended Jan. 26. These three items are to be given separately for: (1) journeymen and mechanics; (2) helpers and apprentices; (3) common labor; and (4) office workers. In addition, the contractor is asked to give the dollar value of contracts received during the calendar month of January, the dollar value of work performed during January with his own forces, and the dollar value of incompleted work as of Jan. 31.

The purpose of these figures is to indicate the proportion of all construction work reported upon through the questionnaires, and by reference to authoritative records of work awarded, to supply the factor by which the summation of replies may be computed to a total report on employment in the construction industry during January. These dollar value figures are to be listed on the four major classifications: (1) one and two-family houses; (2) other buildings; (3) heavy construction; and (4) highways.

The report is to include new construction, remodeling, repairs and maintenance without any exceptions regarding the size of the orders except that Federal Government projects are not to be reported, nor any projects financed by PWA or RFC funds, employment on which is already being reported to the government.

The questionnaire has been developed as a result of exhaustive study and consideration by the Construction Code Authority's Research and Statistics Committee and staff statistician, together with an outstanding group of statistical consultants. It has been approved by the National Recovery Administration and the Central Statistical Board. The information is to be summarized by the Bureau of Census. Every precaution is to be taken to keep the reports of the individual contractors strictly confidential in accordance with the Code.

Each contractor's business may be profitable or unprofitable this year, depending upon the help that the government gives the construction industry. Important decisions may hinge upon the reliability and scope of factual information concerning employment and other conditions in the industry. It is highly important, therefore, that contractors supply the information requested in the questionnaire completely and promptly.

Ruling on Forced Withdrawal of Bids

● Supplementing the opinion of counsel that it is improper and not within the scope of its responsibilities for any Code Authority to cause a member of the industry to withdraw a bid because of an alleged violation of its code, Major Robert N. Campbell, acting division administrator of the N.R.A., has issued the following statement: "A number of cases have been presented in which some Code Authorities and their agencies have been causing bidders to withdraw bids for alleged violations of their respective codes. The penalties for violations of codes are set forth in the Act. It is highly improper and clearly beyond the powers of any such body to attempt to impose additional penalties. The power of the Code Authority is limited to recommendation with respect to alleged violations and does not include power to finally determine that a violation does exist."

Extremists Combine to Obstruct Progress

AS THIS is written the emergency construction program of the President is bogged down in politics. The ostensible reason for its plight is the effort of the American Federation of Labor to enact a provision that labor employed under it shall receive the so-called "prevailing" wages.

The fact is, of course, that if the Senate had voted on the merits of that proposal, it would have been defeated. The amendment was carried by the votes of Senators who do not favor the payment of prevailing wages. In fact, they favor the payment of no wages at all, their one purpose being to block public employment and to care for the unemployed through federal charity. Thus the President's program has been obstructed by a combination of two extremes: one favors an extravagant expenditure and the other opposes any expenditure other than a dole.

By the time this is printed the administration and Congress may have agreed on a program that will command sufficient support to confound the obstructionary tactics of the labor politicians on the one hand and the reactionaries on the other.

AMONG those who seek a constructive outcome, the feeling persists that this triumph of monkey-wrench politics results in part from a failure to define adequately the scope and operation of the program. There has been so much lumping of objectives, agencies, appropriations and authority on a vast scale as to foster misunderstanding, misrepresentation and misgiving.

In general, the proposed legislation covers three distinct functions. First, it is likely that for some time at least no feasible unemployment program can eliminate some measure of direct relief, although it should be a primary objective to reduce this as rapidly as possible. Obviously such payments should not involve any "prevailing" wage scale or other artificial standard.

ON THE other hand, however, it is essential that on normal public works projects the normal procedure of the construction industry should prevail. This means the award of contracts, to the greatest possible extent, to qualified contractors and the payment of established wages and prices. On no other basis can a public works program make the contribution to industrial revival that is one of its major objectives.

But between direct relief and normal public works lies that area of so-called "work relief" which is responsible for the present confusion. Such work should offer compensation higher than a subsistence dole but it should not command the wages that would be justified on normal public works construction. Its objective is to make temporary productive jobs for the largest possible number of unemployed at the lowest possible cost to the community. Such work should be so handled as to incite its beneficiaries to seek employment in private industry, not to encourage them to cling to a government payroll. Moreover, most of those thus employed, coming from every department of business, industry and trade, are not likely to be especially qualified for construction work; it is not reasonable, therefore, to ask that the community pay such workers the same wages that are earned by qualified workers hired on a performance basis.

IT IS to be hoped, therefore, that an amended bill will define more sharply the objectives of the President's program and recognize the difference in employment conditions. It is easy to understand the President's desire to avoid the pork-barrel that would result from a segregation of projects but it is desirable to define more sharply the types of work and procedure.

It must be evident that there is nothing constructive in the amazing demand of the American Federation of Labor that prevailing wages — and to the labor leader that means union scales — be paid to the unemployed whether or not they be qualified to earn them, especially when we remember that most of the jobs are to be improvised for the purpose of making employment. Equally destructive is the demand that we revert to a wholesale and interminable program of governmental charity. These are the extremes; somewhere between is a rational solution. By it we should (1) dispense such charity as may be absolutely unavoidable; (2) maintain through the normal procedure of the construction industry a substantial recovery program of public works construction; and (3) through some form of emergency construction at reduced wages, extend to the remaining unemployed an opportunity to avoid pauperization and earn some measure of public support, while it preserves the incentive to seek a better job in a revived private industry.

Willard Chevalier

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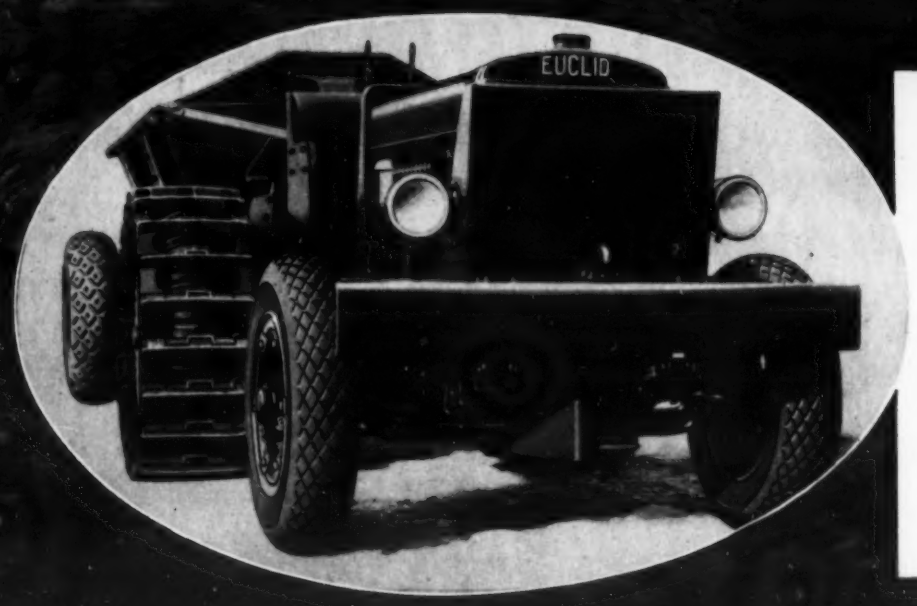

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The operation shown here is at Ft. Peck from which also comes the official report saying:

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G-E 200-hp. motor and G-E control panel for operation of one of the conveyors

A typical section of the conveyor system; belt speed, 600 feet per minute

Another view of the conveyor system in operation

Moving a Mountain a Mile with G-E Motors and Control

Stacker of west-side conveyor system in operation. Note control house on the stacker. Stacker is capable of swinging 180 degrees

G-E SERVICE

The Mason-Walsh-Atkinson-Kier Company, Grand Coulee contractors, and the Jeffrey Manufacturing Company, designers and builders of the conveyor system, have had the co-operation of the G-E organization throughout the planning and installation of the conveyor system. This service began before the system was designed. It will continue until the job is done.

An additional valuable asset to the contractors was the speed with which General Electric made deliveries of equipment. Just three weeks elapsed between the time the order was received and the time the first motors and control were shipped for this job.

The same valuable time- and money-saving service is available to you. Wherever you are, you are near a G-E office. Why not get in touch with the nearest G-E office when you are planning your next construction job? General Electric Company, Schenectady, N. Y.

G-E Equipment Supplied for Conveyor System

Twenty-five 200-hp., 720-rpm. motors with enclosed collectors, for conveyors

Motors—10-hp. to 150-hp.—for operating stacker, shuttle conveyor, and feeders

Automatic centralized control, with interlocking of individual motors

Tellurium-compound control cable
Transformers for distribution of power to motors and lighting system

Note: Six electric and two gas-electric shovels which feed the conveyor system are also equipped with G-E motors, control, and drag-line cable

OTHER G-E EQUIPMENT FOR THE GRAND COULEE PROJECT INCLUDES:

Motors and control for pumps and compressors

Four sets of motors—30-hp. to 200-hp.—and control for Whirley-type cranes

Oil circuit breakers, fuse cutouts, disconnecting switches, and lightning arrestors

Welding equipments
Main-power-transformer substation — four 3333-kva. units

OPERATING 21 hours a day, the mile-long, 5825-horsepower west-side conveyor system at Grand Coulee has begun the gigantic task of literally moving a mountain—11,000,000 yards of overburden from the dam site.

Twenty-five General Electric 200-hp. motors operate the individual conveyors, which range from 200 feet to 275 feet in length. Other G-E motors operate the stacker, a shuttle conveyor, and feeders. G-E control places operation of the entire system at the fingertips of the operator in the control house atop the stacker.

This 60-inch, G-E equipped conveyor system, the largest and longest ever used on a construction project, gives the contractors the following major advantages:

Speed—Earth is being moved at the rate of 45,000 yards a day.

Reliability—Day and night, on a 21-hour-a-day operating schedule, G-E motors and control are giving dependable, continuous operation.

Economy — The contractors at Grand Coulee estimate they will save 60 per cent in the costs of moving this earth by using the electrically equipped, automatically controlled conveyor system.

020-145

GENERAL ELECTRIC

SEEING STARS

ON A 'SKY' OF 'INCOR' CONCRETE

LATEST MEANS of satisfying an age-old interest in the stars is the Hayden Planetarium, now nearing completion at New York's Museum of Natural History. Under a dome of 'Incor' concrete, the "heavens" are projected by apparatus (above), as finely built as a watch, which shows the sky exactly as it looks outside on a clear night.

Interesting, too, is the construction of the dome itself—a semi-sphere, 80′ in diameter, with a shell of 'Incor' concrete 3″ thick. Built on an ingeniously designed wooden form, over a layer of insulating material (left), the concrete was placed with cement gun (shown at the right). A dry mixture of cement and aggregate, blown through the larger hose, mixed in the nozzle with water coming through the smaller hose, was shot into place under 65-lb. air-pressure.

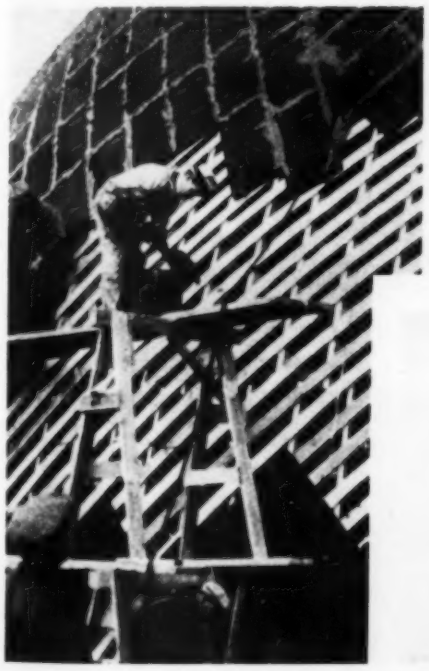
The "Cold-Night" Problem

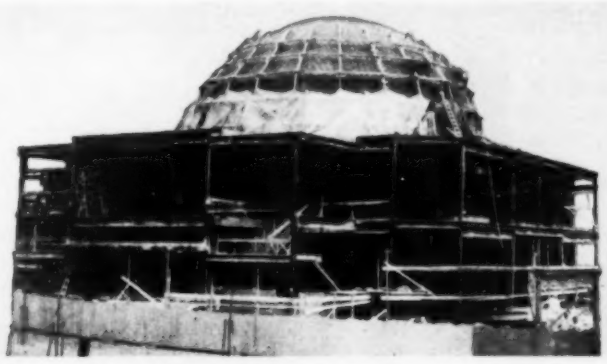
To protect against the hazard of sudden frost, always present in Spring or Fall, even when days are warm and sunny, 'Incor' 24-Hour Cement was used. With 'Incor', this concrete, placed in November, attained service strength in 24 hours, with minimum protection.

Because an 'Incor' mix hangs together better, there was less rebound from the cement-gun. Loss of material from this cause, often as much as 20%, was negligible. 'Incor'* is made and sold by producers of Lone Star Cement, subsidiaries of International Cement Corporation, New York; also sold by other leading cement manufacturers.

*Reg. U.S. Pat. Off.

'INCOR' 24-Hour Cement





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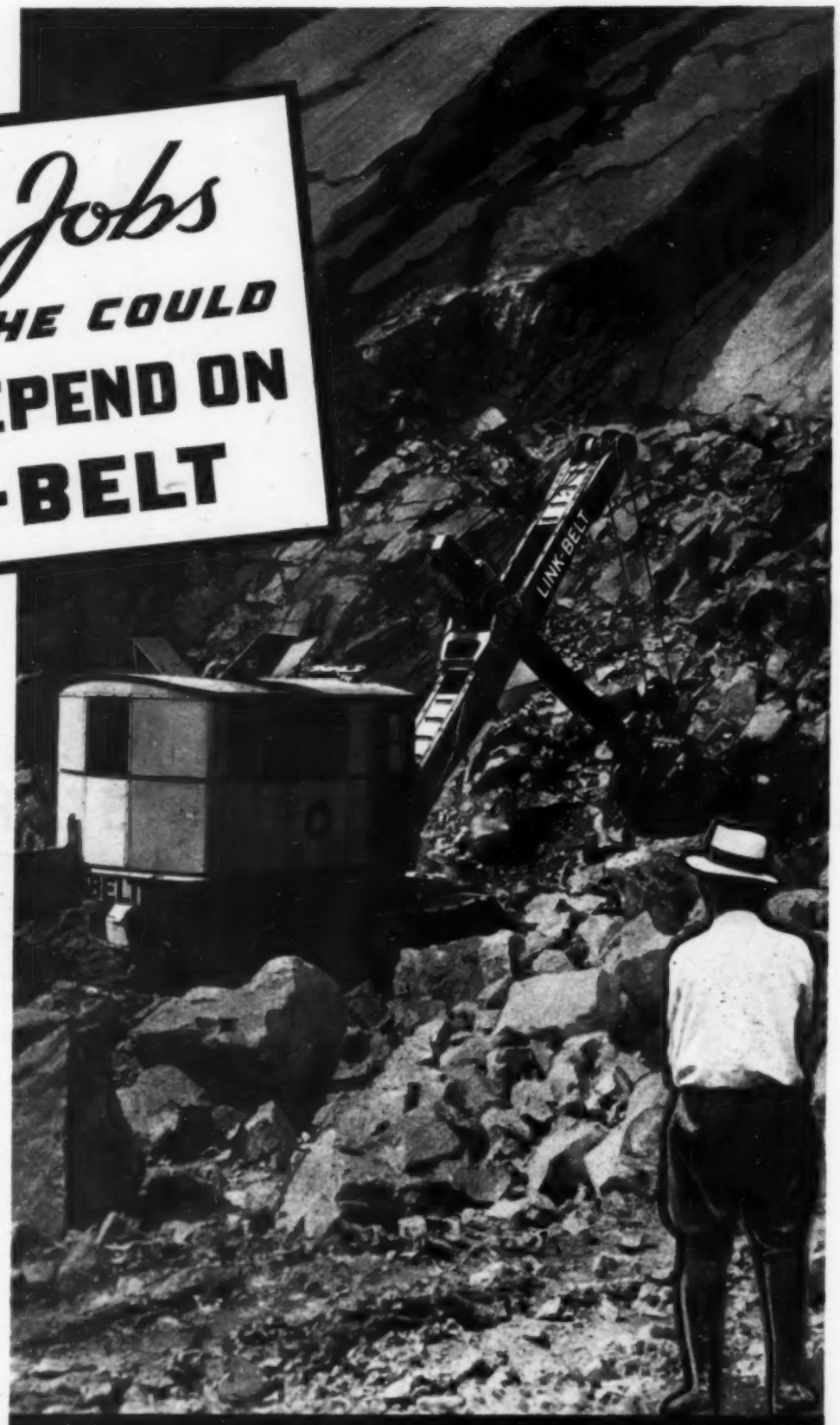
TAUGHT HIM HE COULD
ALWAYS DEPEND ON A LINK-BELT



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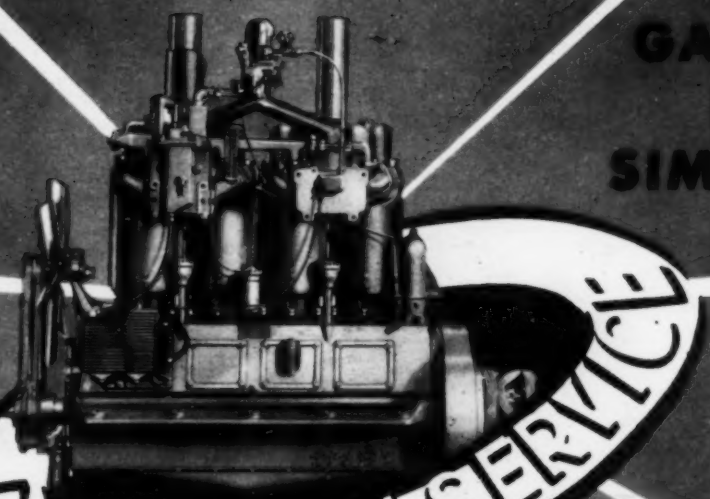

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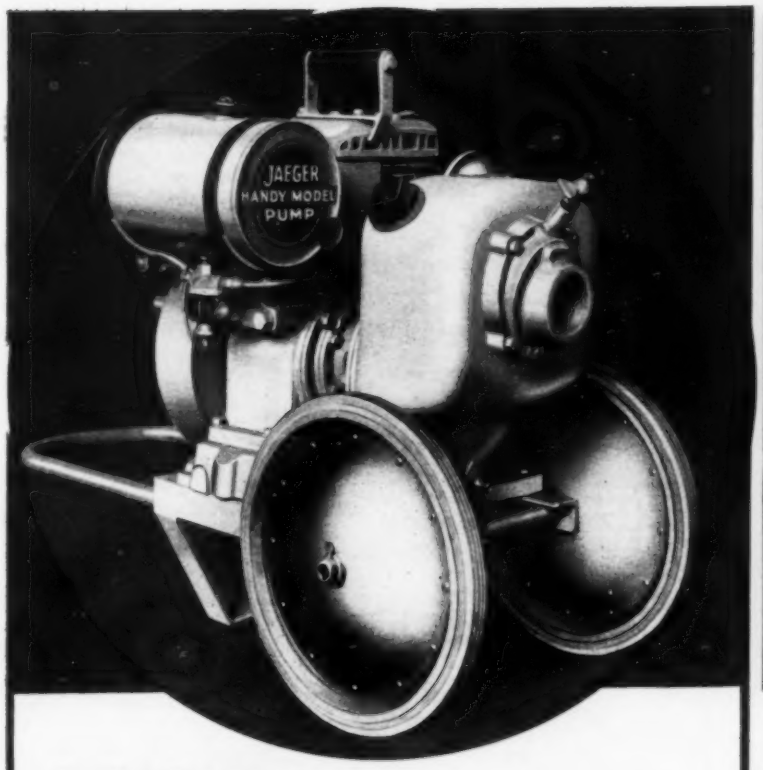

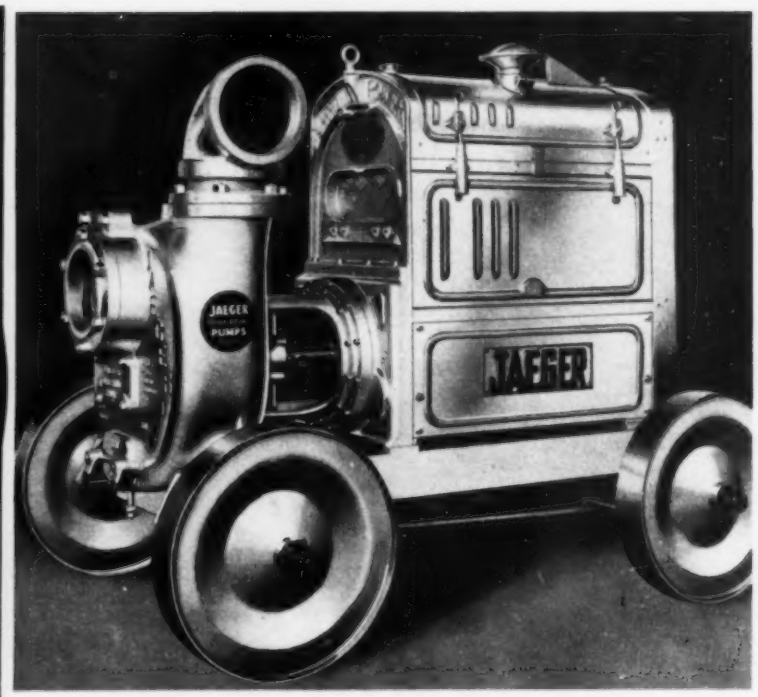

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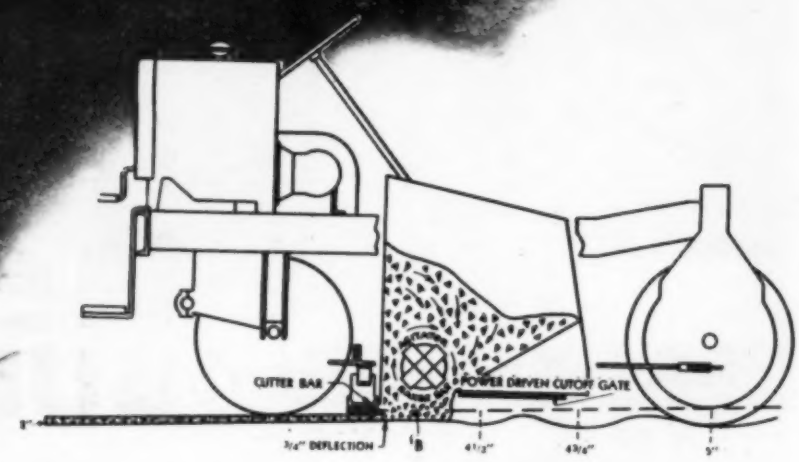

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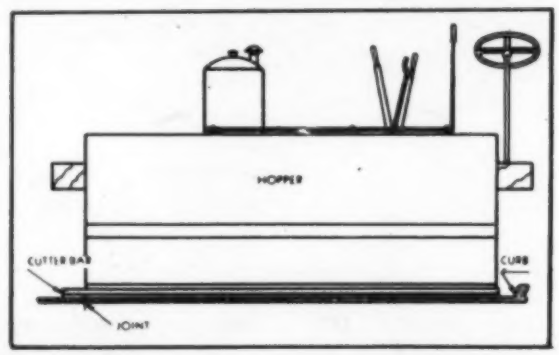

The top diagram above shows an Adnun Paver on an exaggerated grade. Assuming a course of 2" the front wheel will be seen to have dropped into a 3" hole. Even in this extreme case the deflection of the cutter bar is only ¾".

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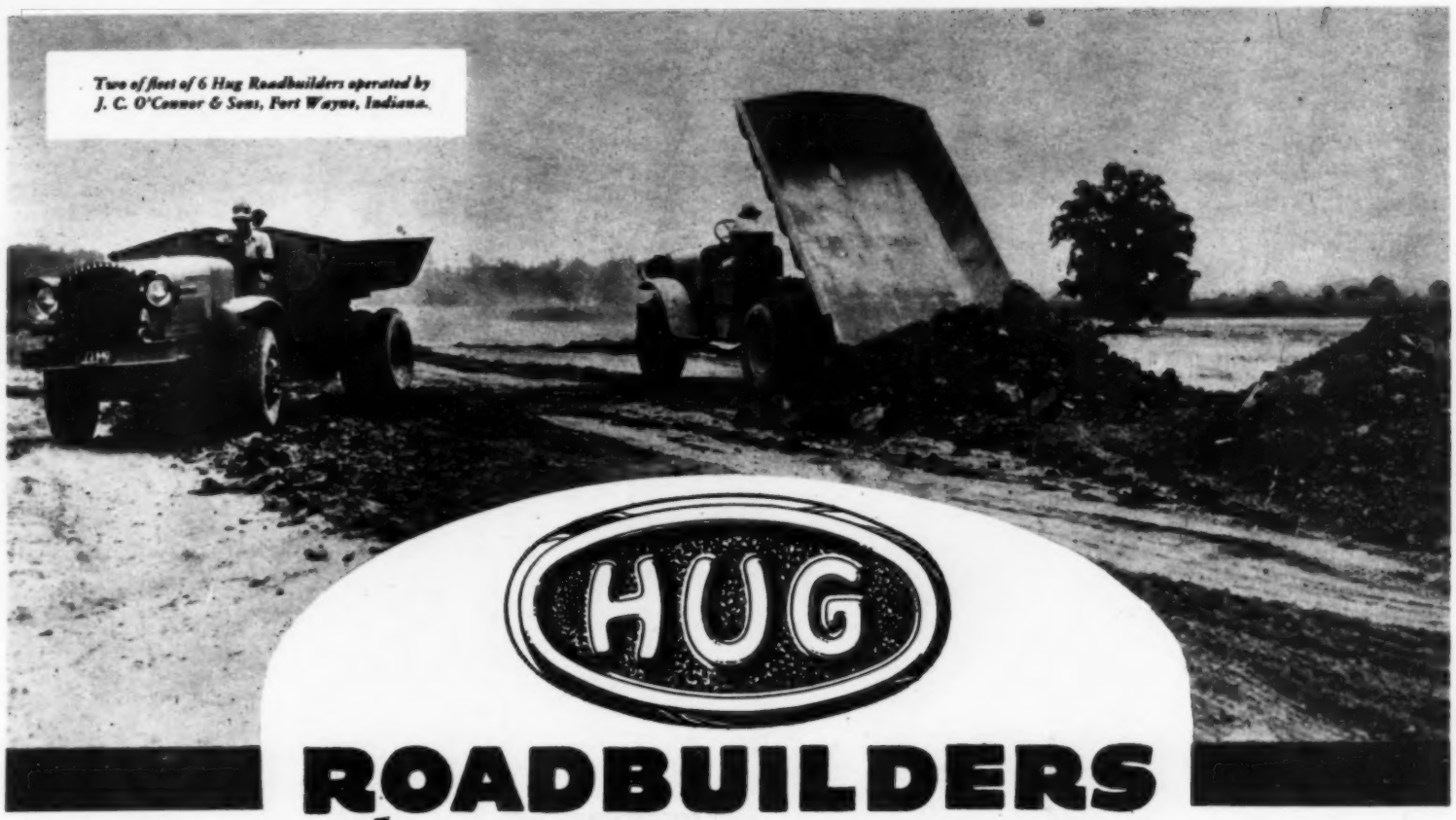

Two of fleet of 6 Hug Roadbuilders operated by J. C. O'Connor & Sons, Fort Wayne, Indiana.

HUG ROADBUILDERS

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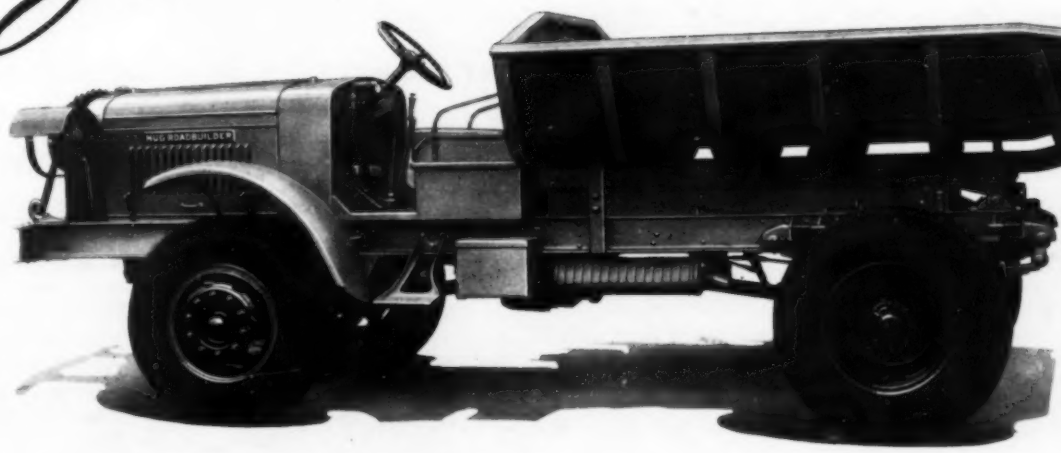


MODEL 87Q HUG ROADBUILDER

Equipped with powerful heavy duty 6-cylinder full Diesel engine—8-inch "I"-beam frame—full-floating double reduction rear axle—powerful transmission with 10 speeds forward, 4 speeds reverse—Hug set-back wheel design—short wheelbase—famous Hug front axle rocker action—low-mounted, heavy duty 5-6 yard dump body—heavy duty dual rear wheels. Also equalized load distribution and passenger car ease of steering.

With half the equipment, Hug Roadbuilders do most "tractor jobs" *twice as fast*. That cuts dirt moving costs 75%!

Impossible? Let us prove it. Write for the names of contractors who are saving money this way every day.

Hug Roadbuilders are faster. They are flexible. They turn short. They spot "right now". They whisk in under elevating graders and out again with a zip that puts other equipment in the team and wagon class for comparative speed and costs.

And now that Hugs are available with full Diesel engines, they concede nothing to anything else on wheels in low operating costs. Besides—and this is important—Hug service costs are far less and costly lay-ups are avoided. Because far less equipment is needed to handle a job—you have much less invested.

Write today for full particulars, proof and prices.

Hug Roadbuilder Trucks can be furnished with either gas or full Diesel engines.

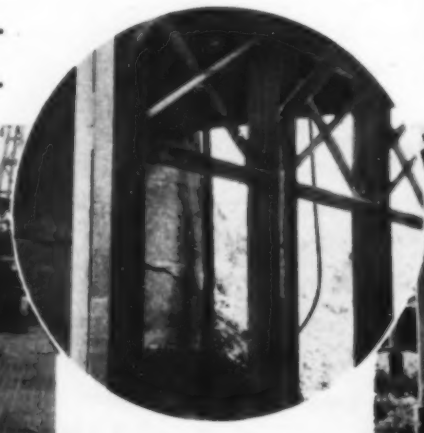
THE HUG COMPANY
504 CYPRESS ST. • HIGHLAND, ILL.

"BUILT TO MEET A CONDITION"

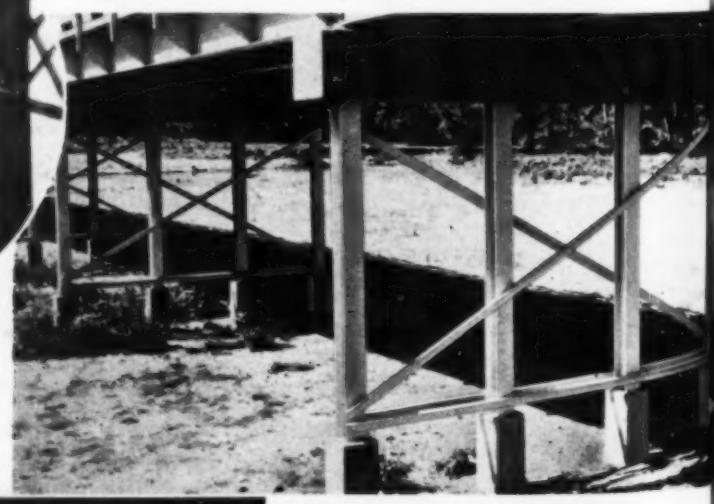
An OLD FASHIONED ARGUMENT FOR STEEL

The recent burning of the Logansport Bridge over the Sabine River between Texas and Louisiana emphasizes the need for all steel construction because of its firesafe qualities. This was a steel bridge, it is true, but vulnerable in its wood approaches, supports and flooring. • Several new Carnegie developments now provide this all-steel construction.

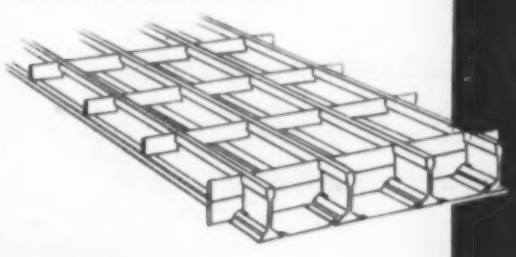
T-Tri-Lok and I-Beam-Lok assure a fireproof, armored, anti-skid surface of long life and high efficiency. CBP Sections, designed particularly for bearing pile service, are suitable for any installation, but especially efficient where deep penetration is required and driving conditions are severe. Let us work with you on your next design.



Showing excellent condition of fabricated steel bearing piles after thirty-five years of exceptionally severe service.



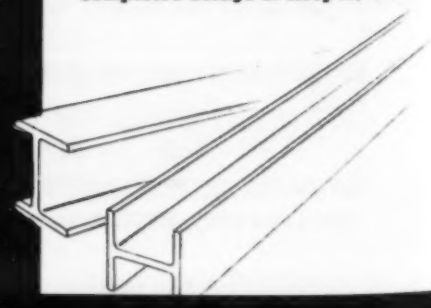
I-Beam-Lok ready for concreting on East Grand Boulevard Viaduct over the Grand Trunk Railway lines, Detroit.

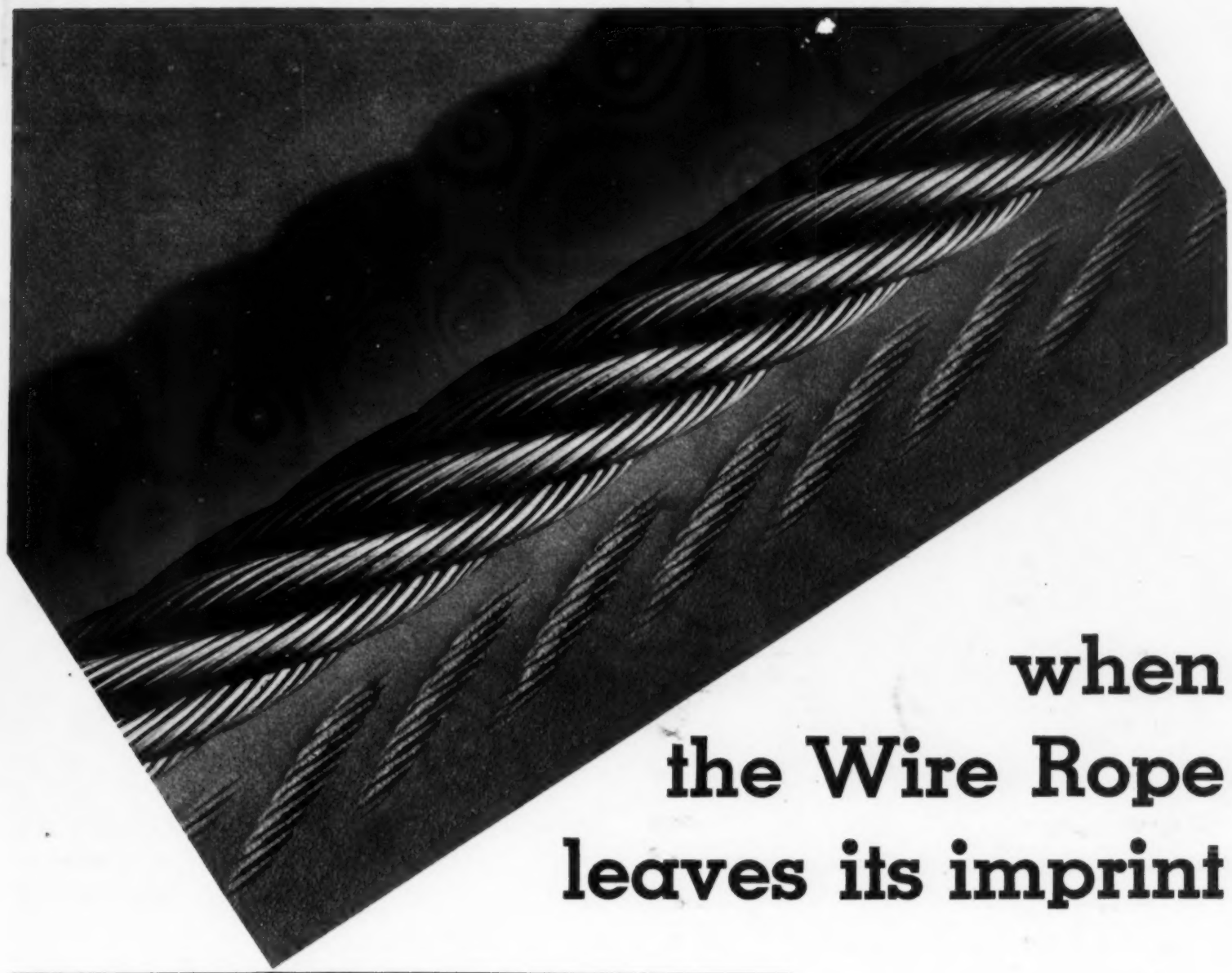


CARNEGIE STEEL COMPANY

US STEEL

Combined bearing piles and trestle bent members on approaches to the recently completed bridge at Leeper, Mo.





when the Wire Rope leaves its imprint

Know your Ropes

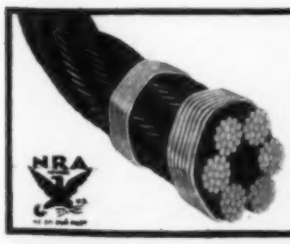
...This is a helpful hint, how to make wire rope last longer. Subsequent Wickwire Spencer advertisements in this publication will give other dollar saving information. Tell us about your rope problem and we will give you the answer.

If there is an imprint of the rope in the sheave or drum groove there is a filing action on the rope at every start and stop. Furthermore, when a new rope is installed of a different lay pattern, these impressions have a tendency to injure the wires in the outer strands. Both conditions materially shorten rope life. Grooves having the slightest impressions should be machined and polished. We will gladly send you a table of maximum and minimum tolerances to consider when regrooving and suggestions of metal to use for sheaves and drums. Write your request for information.

•

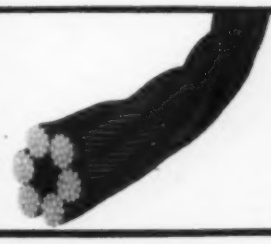
WICKWIRE SPENCER STEEL CO., New York City; Buffalo, Chicago, Worcester; *Pacific Coast Headquarters:* San Francisco; *Warehouses:* Portland, Los Angeles, Seattle. *Export Sales Dept.,* New York City.

WIRE ROPE
by Wickwire Spencer

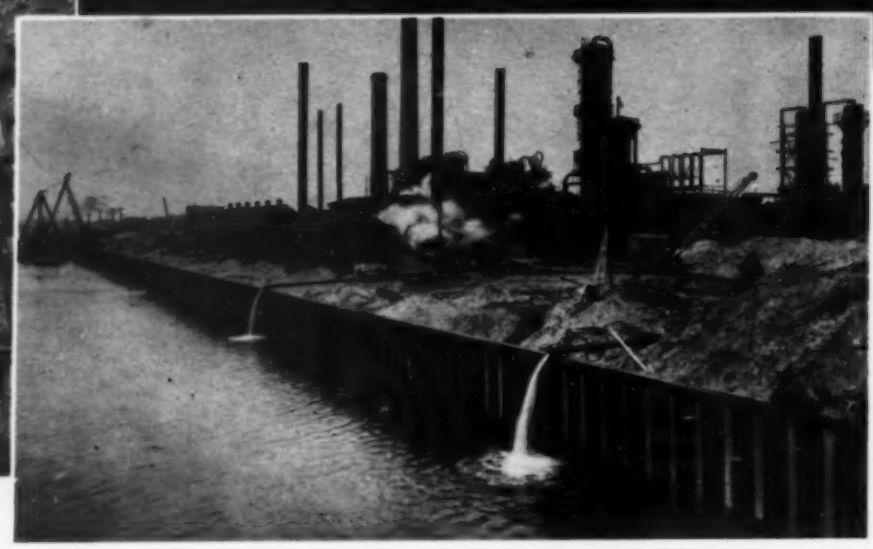


BOTH...STANDARD LAY AND WISSCOLAY PREFORMED.

Wickwire Spencer manufactures all sizes and types of Wire Rope in standard lays and preformed. Wisscolay preformed wire rope will often solve a wire rope application difficulty. Ask our engineers where and when it should be used. Send for a free WIRE ROPE BOOK. It will prove of great value.

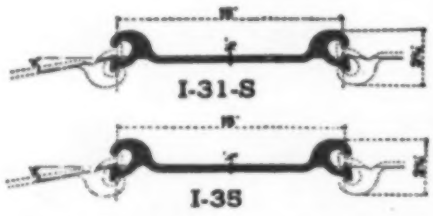


Many Use INLAND STEEL SHEET PILING As River and Harbor Development Speeds Dock Construction



Above: 350-foot dock under construction, Omaha Packing Co., Chicago River, Chicago, Ill.; 175 tons Inland Section I-27 used. *At right:* 800-foot dock, Wadhams Oil Co., East Chicago, Ind.; 600 tons Inland Section I-32 used.

New Sections



With the addition of the sections shown above Inland produces a complete line of sheet piling. Properties of the new sections:

	I-31-S	I-35
Wt. per foot	38.8 lbs.	43.8 lbs.
Wt. per square foot of wall	31.0 lbs.	35.0 lbs.
Section Modulus	3.7 in.^{3}	3.8 in.^{3}
Section Modulus per lin. ft. of wall	3.0 in.^{3}	3.1 in.^{3}
Min. Strength of interlock per lineal inch in direct tension	12,000 lbs.	12,000 lbs.

THE great Public Works program progresses—rivers are deepened, widened, placed under control—harbors are dredged, protected—and thus new avenues of transportation are made available for American industry.

Cities, states, other public agencies—industries of all description—are preparing themselves to take advantage of these new facilities. A dock building program of vast proportions is under way.

Foresighted builders are using Inland Steel Sheet Piling for these docks—assuring strength, permanence, shore protection, and an attractive installation as well.

Inland produces all of the nine standard sections of steel sheet piling. Our experienced engineers are at your service. Consult them regarding your dock building problems. INLAND STEEL COMPANY, 38 South Dearborn Street, Chicago, Illinois.

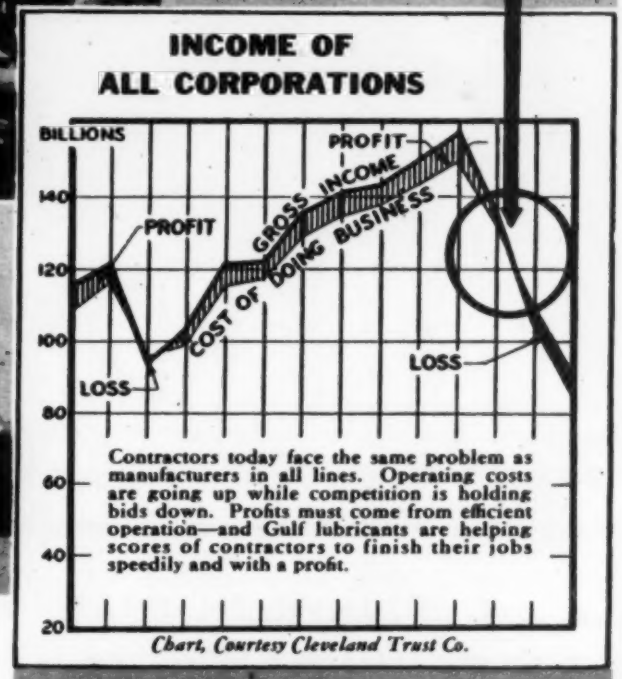
NRA U.S. CODE

INLAND STEEL

Sheets Strip Tin Plate Plates Structurals Piling Rails Track Accessories Bars Rivets Billets

PROFIT OR LOSS ON YOUR JOB?

GULF KEEPS CONTRACTORS' PROFITS OUT OF THIS SQUEEZE



Contractors today face the same problem as manufacturers in all lines. Operating costs are going up while competition is holding bids down. Profits must come from efficient operation—and Gulf lubricants are helping scores of contractors to finish their jobs speedily and with a profit.

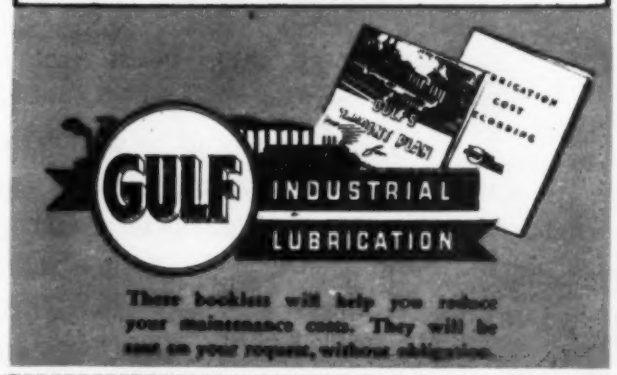
Chart, Courtesy Cleveland Trust Co.

These two interesting views show the humming activity at the Cape Cod Canal Bridge project in New England where the P. J. Carlin Construction Company carried on all foundation work for the two great bridge spans across the canal. Gulf lubricants kept all equipment on the job with low costs for maintenance.

CONTRACTORS on all types of jobs are speeding their work and keeping profits out of the "squeeze" by the use of Gulf quality lubricants.

Maintenance costs for heavy equipment on big jobs can take a heavy toll from profits. Gulf engineers help contractors keep all their equipment continuously on the job without costly delays for repairs and replacements.

A Gulf engineer will be glad to survey your equipment and suggest means of improving its lubrication.



These booklets will help you reduce your maintenance costs. They will be sent on your request, without obligation.

GULF REFINING COMPANY CM-3
3800 Gulf Bldg., Pittsburgh, Pa.

Gentlemen: Please send me without obligation, the booklets, "Lubrication Cost Recording," and "Gulf's 7-Point Plan for Industrial Lubrication."

Name.....

Title.....

Company.....

Address.....

GULF REFINING COMPANY, PITTSBURGH, PA.

District Sales Offices:

Boston New York Philadelphia Atlanta New Orleans
Houston Pittsburgh Louisville Toledo

Triumphal Arches OF A NEW ORDER

A TRIUMPH IN GRACE AND BEAUTY . . . AND IN PRACTICABILITY

● Here in the new International Livestock Pavilion at Chicago, these Beam Arches, fabricated from CB Sections, span a vast arena nearly two hundred feet from wall to wall. The impression is one of soaring, sturdy grace—of simplicity yet strength. The roof is "uncluttered." The depth of the beam arches is so shallow that there is no possible interference with vision from any point, yet the walls have been kept economically low.

Erection of Beam Arches is rapid and relatively low in cost. It will pay you to investigate the possibility of this new type of construction on any project where wide spans are involved. Descriptive literature will be sent upon request.

ILLINOIS STEEL COMPANY

208 SOUTH LA SALLE STREET, CHICAGO, ILLINOIS

CARNEGIE STEEL COMPANY, PITTSBURGH

United States Steel Corporation Subsidiaries

If you didn't see American Cable's page in January publications, write us and we'll send you a reprint. It tells a story you should know.

"Longer service MAKES TRU-LAY most economical"

A WIRE rope buyer recently made the statement that: . . . "They are asking a premium for Tru-Lay, and no one can convince me it gives that much longer service."

To which we replied: "You surely haven't seen the Tru-Lay message for January because, if you had, you would realize that more and more rope users are coming to realize that the increased service given by Tru-Lay Preformed is all out of proportion to the price differential.

". . . Here—look at this chart. It shows exactly the progress of Tru-Lay Preformed Wire Rope—since its introduction in 1924. . . . And remember, please, five of those years were depression years—when prices were scanned as never before. . . . In 1924 Tru-Lay Preformed absorbed only 3.9% of American Cable Company's entire volume. Now—after a steady climb—it commands 79 or 80 percent of our entire plant production. A product has to be right to command that buyer acceptance.

"Tru-Lay Wire Rope *is* right—because it is preformed. Preforming eliminates all the internal stress characteristic of non-preformed rope—with the result that it gives you *much more* trouble-free service than any other brand. . . . The chart in this "ad" proves it by revealing buyer acceptance. . . . You know how everyone has been trying to buy cheap. Well, this chart proves that Tru-Lay Preformed Wire Rope must be cheapest in the long run."

AMERICAN CABLE COMPANY, *Inc.*
WILKES-BARRE, PENNSYLVANIA
An Associate Company of the American Chain Company, Inc.
"In Business for Your Safety"

District Offices: Atlanta Chicago Denver Detroit New York Philadelphia Pittsburgh Houston San Francisco

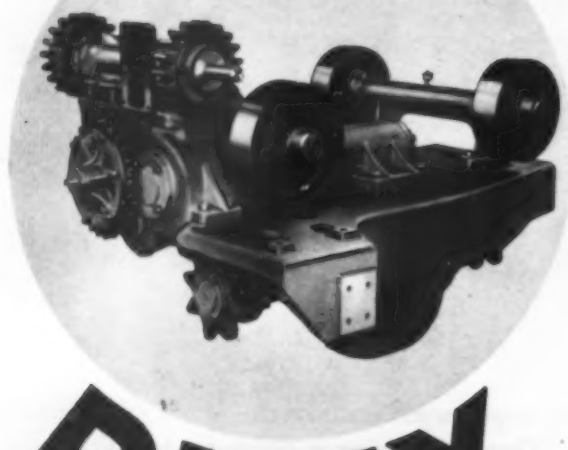
NRA CODE ACCO A·C·C

TRU·LAY * *Preformed* Wire Rope

* PREFORMED ROPE IS MADE IN ALL TYPES, GRADES, CONSTRUCTIONS AND LAYS

KOEHRING

HEAVY DUTY



Koehring Heavy Duty construction for long life and dependability is shown in this single steel base-plate casting which supports the drum (through the drum rollers), the drum drive, the traction drive, and the traction shaft assembly. The casting is supported in the main frame at three points, eliminating the possibility of excessive strain or misalignment.

27-E *autocycle* PAVER

For 1935 you will need a paver having high speed production combined with low maintenance cost. You cannot afford to operate inefficient and obsolete equipment.

The Koehring 27-E Autocycle Paver is fast, efficient and dependable.

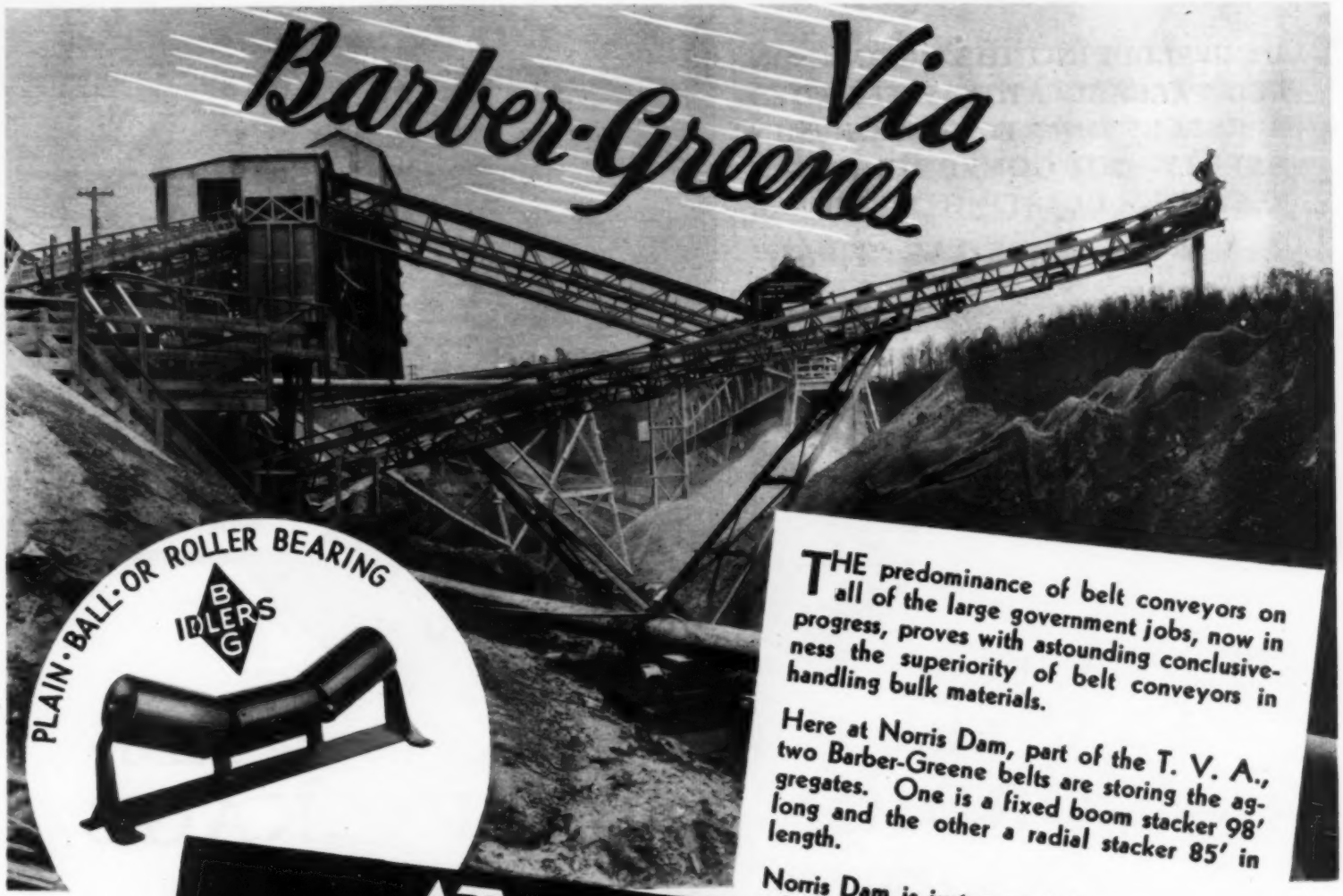
Opportunity for profit will depend upon the ability to complete your job at *lower than average* cost. The most efficient and dependable equipment is a vital factor in securing this *lower than average* cost.

Investigate the Koehring 27-E Paver.

KOEHRING COMPANY

MILWAUKEE WISCONSIN

Barber-Greenes Via



AT NORRIS DAM

THE predominance of belt conveyors on all of the large government jobs, now in progress, proves with astounding conclusiveness the superiority of belt conveyors in handling bulk materials.

Here at Norris Dam, part of the T. V. A., two Barber-Greene belts are storing the aggregates. One is a fixed boom stacker 98′ long and the other a radial stacker 85′ in length.

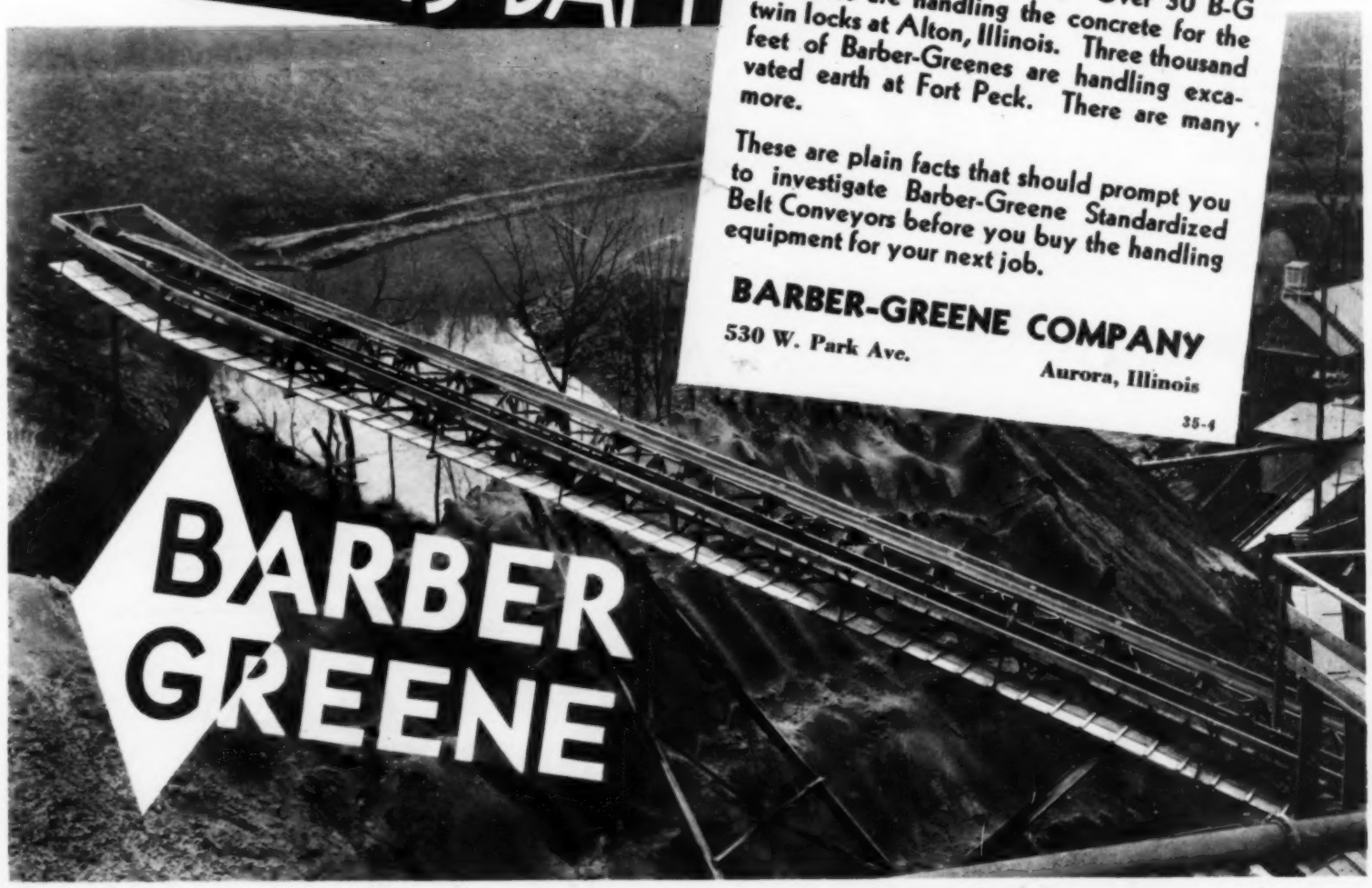
Norris Dam is just one of the many current jobs where Barber-Greenes are delivering materials for the lowest cost and in the shortest time. The aggregates for the locks at Quincy, Illinois, and Saverton, Missouri, are being carried via Barber-Greenes. Over 30 B-G Portables are handling the concrete for the twin locks at Alton, Illinois. Three thousand feet of Barber-Greenes are handling excavated earth at Fort Peck. There are many more.

These are plain facts that should prompt you to investigate Barber-Greene Standardized Belt Conveyors before you buy the handling equipment for your next job.

BARBER-GREENE COMPANY

530 W. Park Ave. Aurora, Illinois

35-4



IN DEVELOPING THE ACCORDION FOLD PACKAGE, ATLAS EFFECTED A REVOLUTIONARY ADVANCE IN SAFETY AND CONVENIENCE IN ELECTRIC BLASTING METHODS.

—AN ATLAS "FIRST!"

Today the use of

ATLAS Electric Blasting Caps in the handy ACCORDION FOLD PACKAGE has become Standard Practice

Atlas introduced the Accordion Fold Package for Electric Blasting Caps in March, 1933. Its advantages are so obvious that in two years the Atlas Accordion Fold Package has been accepted everywhere. No blaster can afford to overlook this Atlas "First." Are you making the most of it?

The photographs tell the exclusive ATLAS story

(1) The entire length of the leg wires, supported by the tube, surround, enclose and cushion the detonator. It is handy to carry—and handy to use.

(2) The package is easily opened—a simple pressure of the fingers and the package breaks open along the indented line. The tube is thus destroyed and the cap is ready for use.

(3) The wires are kept folded accordion-wise so that they extend naturally into position.

(4) It is easy to straighten out the cap end for priming without disturbing the rest of the Accordion Fold.

ATLAS POWDER COMPANY, WILMINGTON, DEL.

Cable Address—Atpowco

Everything for Blasting

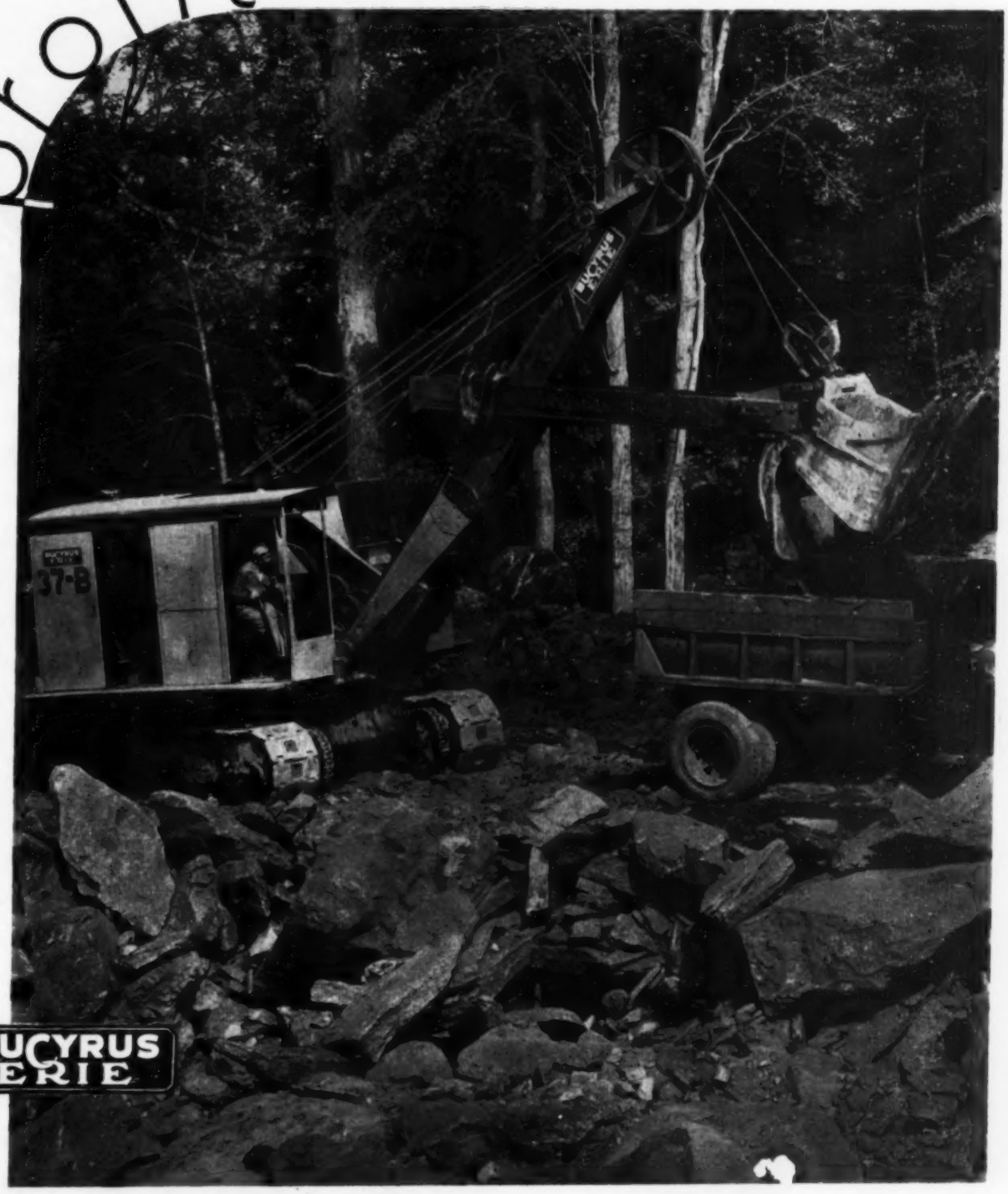
OFFICES

Allentown, Pa.	Joplin, Mo.	New Orleans, La.	Pittsburgh, Pa.	Spokane, Wash.
Boston, Mass.	Kansas City, Mo.	New York, N. Y.	Portland, Oregon	St. Louis, Mo.
Butte, Mont.	Knoxville, Tenn.	Philadelphia, Pa.	Salt Lake City, Utah	Tamaqua, Pa.
Denver, Colo.	Los Angeles, Calif.	Picher, Okla.	San Francisco, Calif.	Wilkes-Barre, Pa.
Houghton, Mich.	Memphis, Tenn.	Pittsburg, Kansas	Seattle, Wash.	

ATLAS
EXPLOSIVES

INSURE your profits with modern Bucyrus-Erie speed, power and control. Modern speed that increases output through fast digging, swinging, dumping, moving. Modern power that digs dirt fast and means sustained speed through the toughest going. Modern control that puts safely in the operator's hands full use of the speed and power built into these outstanding machines. Profits, impossible with obsolete machines, are within your reach when you apply modern Bucyrus-Erie performance to your jobs.

profit



BUCYRUS-ERIE

EXCAVATING, DRILLING, AND MATERIAL-HANDLING EQUIPMENT...SOUTH MILWAUKEE, WISCONSIN

WHAT DO YOU MEAN · · *More Work?*

Just that! With Cordeau-Bickford Detonating Fuse each cartridge has the added force of a primer cartridge—"goes" with its maximum force —does more work. This is because the Cordeau is in intimate contact with all the cartridges in a hole and acts as an individual detonator for each.

You can use fewer but larger shots—drill all the holes at one time, hook up with Cordeau and fire them all at the same time. Shots can be planned to give a maximum amount of rock through successive relief of burden.

Thus Cordeau not only results in *more work*, but its use generally means better fragmentation, easier removal.

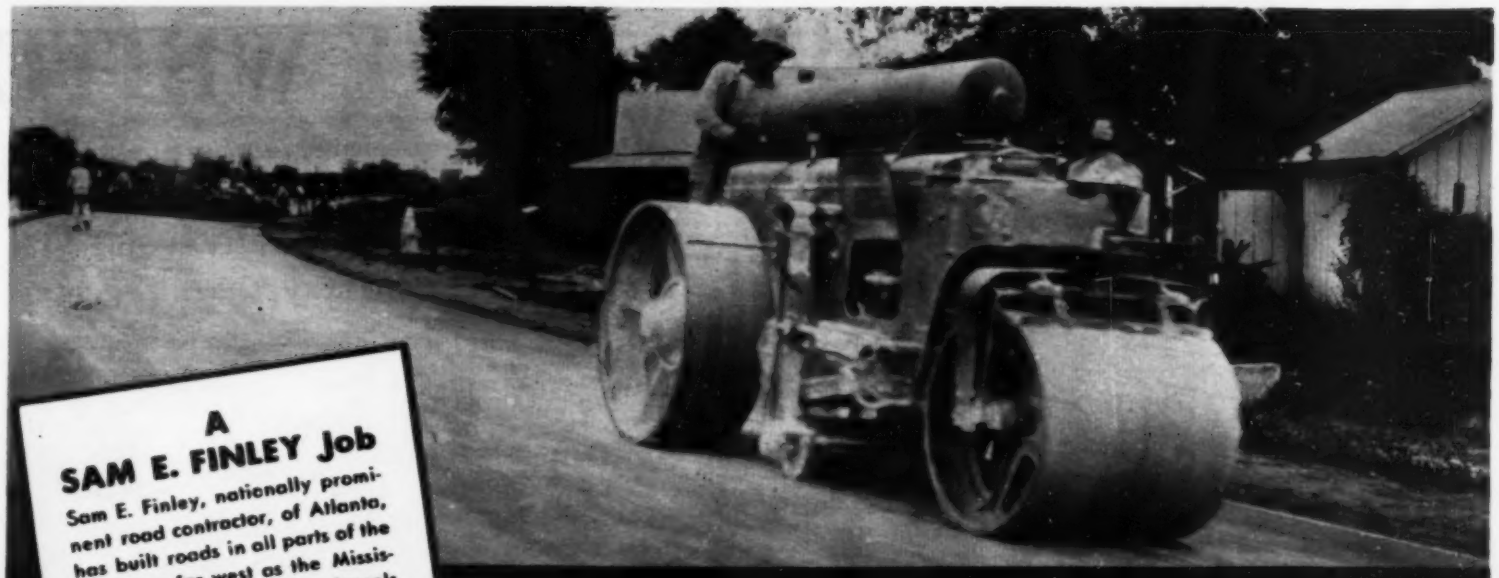
But *more work* is only one way in which Cordeau pays. Learn the others! Watch succeeding advertisements or write to us. THE ENSIGN-BICKFORD COMPANY, Simsbury, Connecticut. *Estab. 1836.*

CORDEAU DETONATING FUSE BICKFORD

ALSO SAFETY FUSE *Since* 1836

THE ENSIGN-BICKFORD COMPANY

CB-40



A SAM E. FINLEY Job

Sam E. Finley, nationally prominent road contractor, of Atlanta, has built roads in all parts of the South, as far west as the Mississippi. Last fall he won new laurels when he finished the Luverne, Alabama road.

This already famous seven-mile stretch of sand-asphalt highway, even though it has sharp, superelevated curves, is the smoothest "black top" road in the country. And the Austin Roll-A-Plane, Mr. Finley will tell you, played a most important part in building it.

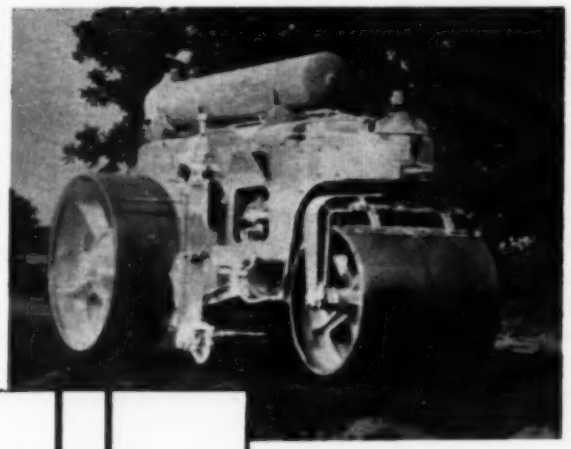
BEATS SPECIFICATIONS

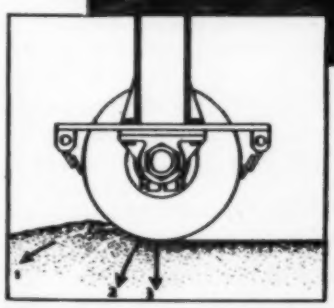
Operator, Rolling Roads 8 Years, Uses **ROLL-A-PLANE** First Time— Declares, *"Smoothest I ever put down!"*

● **Sam E. Finley usually goes his specifications "one better" and he did at Luverne, obtaining, with the Roll-A-Plane, a 1/8" tolerance in 10' instead of the 3/16" called for. One of the operators of the five Roll-A-Planes on this job explains it this way: "This knot bumper is a great thing. It saves a lot of rolling. This is the first time I've used one and the road is the smoothest I've put down in the eight years I've been at this kind of work."**

Already state highway departments across the country know a better tolerance can be gotten than is required by their standard specifications. Modification of the specified 1/4" tolerance in 10' has already been made in several cases. The new clauses written into state specifications call for 1/8" in 10'—and to reach such tolerance quickly and economically requires an Austin-Western Roll-A-Plane. It can easily be forecast that new clauses will be written into all road specifications universally.

All who purchase new rolling equipment will want to prepare for the new conditions. If present specifications do not call for the immediate purchase of one or more Roll-A-Planes, may we suggest this: Be sure in buying new equipment to get Austin-Western Rollers of the three-wheel type. These will not become obsolete because provision has already been made for converting them into Roll-A-Planes as needed.





The Roll-A-Plane's third, small diameter roller establishes a plane by its Leveling Action, Kneading Action and Spot Pressure. (1) by pushing the bump first forward, (2) then slant-wise, (3) then straight down, it quickly achieves a smoothness that cannot be obtained with ordinary rollers regardless of the 45-ing and cross-rolling done.

Send for complete descriptive bulletin on the Roll-A-Plane.

The Austin-Western Road Machinery Co.
A-6, Aurora, Illinois
Please send me complete details on the Austin-Western Roll-A Plane.
Name .....
Address .....
City ..... State .....

ROAD GRADERS · MOTOR GRADERS · ELEVATING GRADERS · DRAGS

ROAD ROLLERS

Austin-Western

DUMP WAGONS

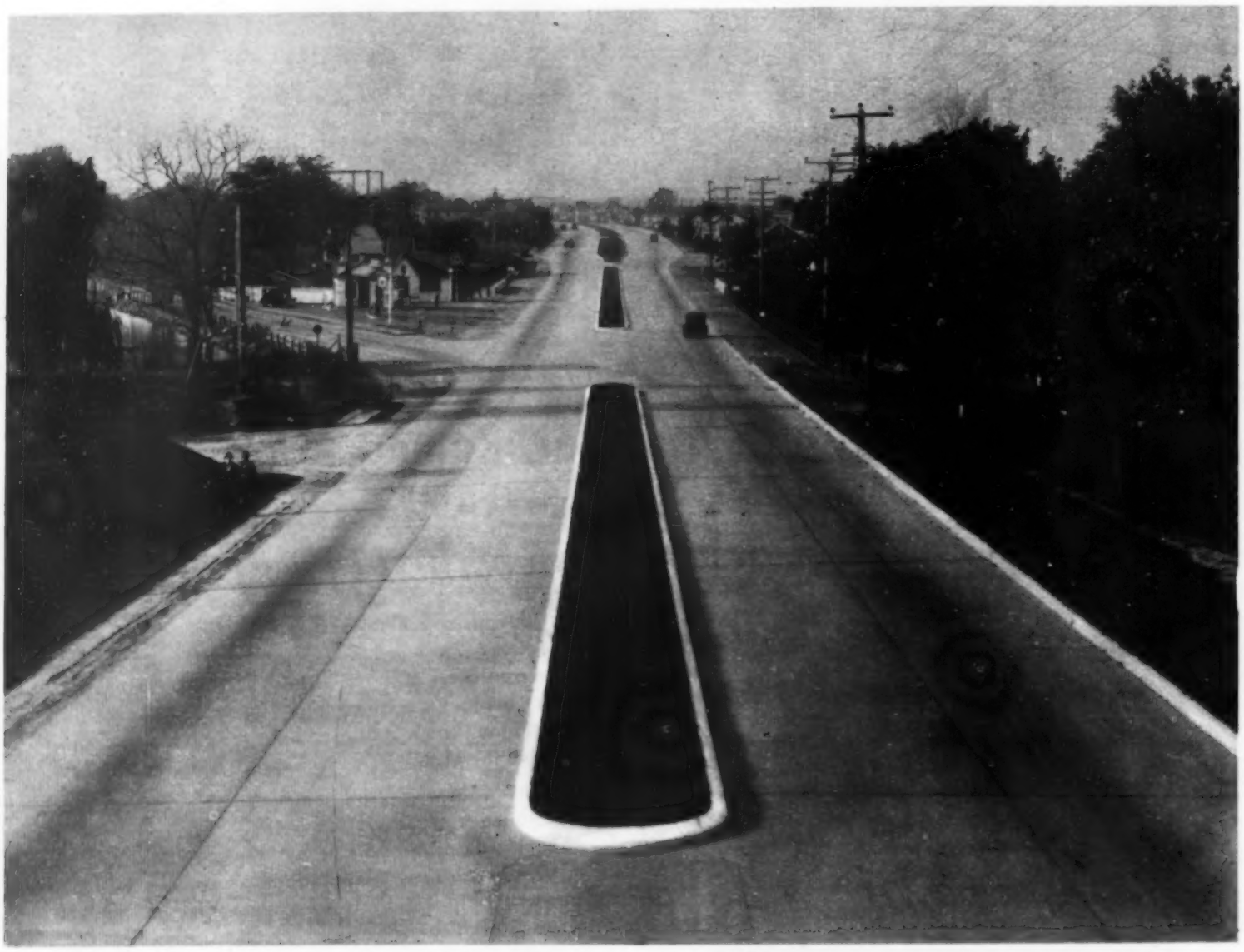
BITUMINOUS DISTRIBUTORS · ROAD-MIX MACHINES · CULVERTS
SCARIFIERS · BULLDOZERS · TRAILERS · SCRAPERS · PLOWS

DUMP CARS

CRUSHING AND WASHING PLANTS · SWEEPERS AND SPRINKLERS · SHOVELS · CRANES · ETC · SNOW PLOWS

WHITE CURBS THAT *STAY* WHITE

Atlas White concrete curbs make parkway and safety island stand out sharply and distinctly—and they make them stay that way.



Atlas White parkway curbing on U. S. Highway No. 13, leading into Smyrna, Delaware. Curbing installed by Gooden & Clark, Dover, Delaware, under supervision of the Delaware State Highway Department, W. W. Mack, Chief Engineer.

DRIVING into Smyrna, Delaware, you are impressed with the well-planned system of traffic control on the highway pictured here. Parkway islands separate incoming and outgoing traffic. On the outskirts the islands are seven feet wide. As the road widens in town, the islands widen to seventeen feet. And every island stands out clearly—easy to see for safety and nice to look at for appearance' sake—marked distinctly with spic and span *white* curbing made with Atlas White portland cement.

Those curbs will *stay* white, too. They're built of white concrete. They won't fade. They won't turn gray. Every rain washes them clean and white. The cost of installation is the only cost—no maintenance—no replacement. They are *indelibly* white. You'll be interested in the details and the economy—write Universal Atlas Cement Co. (*United States Steel Corporation Subsidiary*), 208 South LaSalle Street, Chicago.

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ATLAS WHITE MARKERS AND CURBS

Made with Atlas White Portland Cement—Plain or Waterproofed

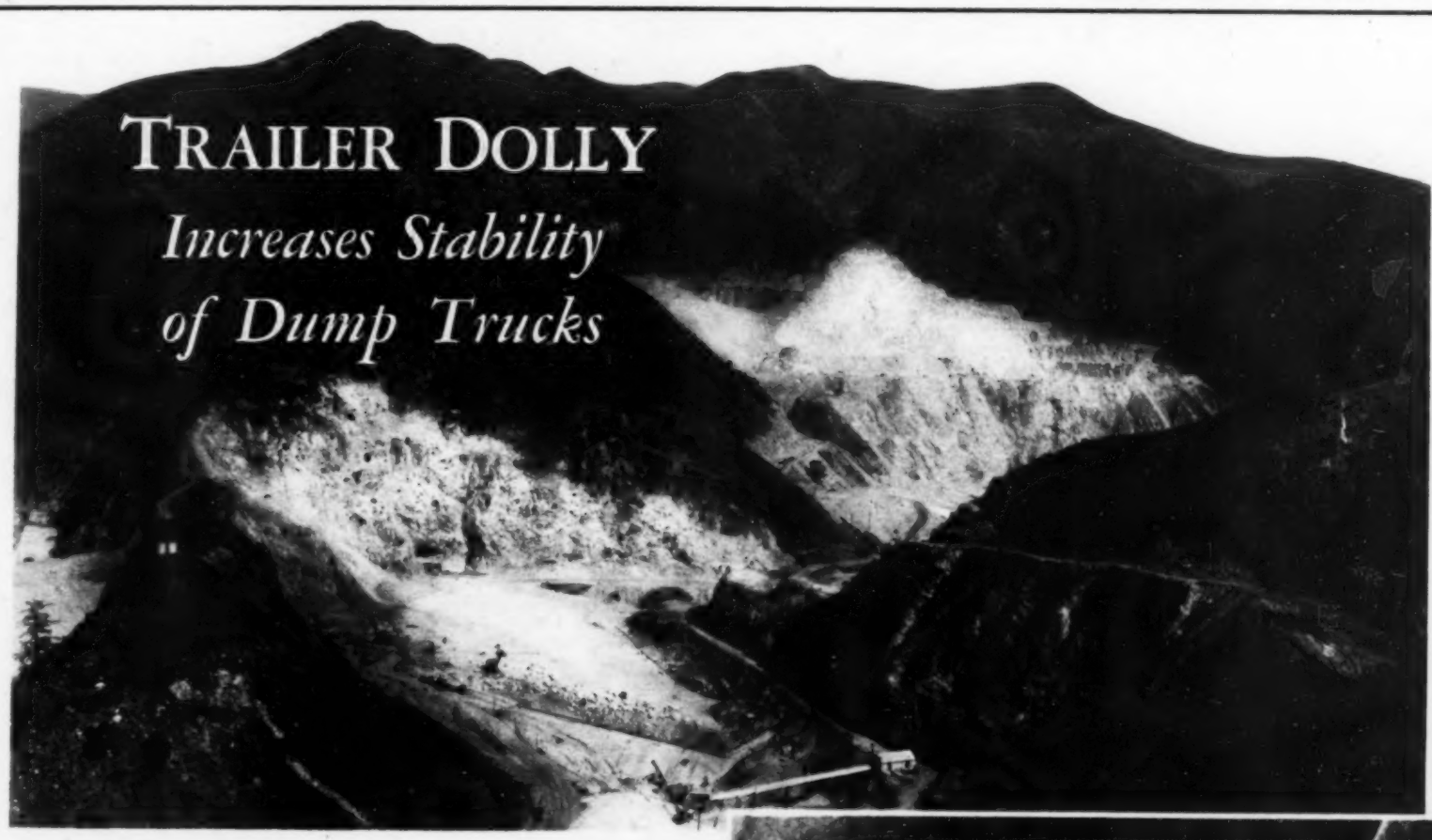
Construction Methods

NRA CODE

ROBERT K. TOMLIN, Editor

Established 1919—McGraw-Hill Publishing Company, Inc.

Volume 17—Number 3—New York, March, 1935



SITE OF SAN GABRIEL NO. 1 DAM *(above)* with concrete toewall in foreground and extensive face of Quarry No. 10 on side of canyon in background. TRAILER DOLLY *(in inset)* equipped with hydraulic cushion prevents overbalancing of truck in dumping. Truck body has been slightly inclined, and dolly wheels are approaching pavement surface. When they begin to take weight, overturning is impossible.

IN THE QUARRYING OPERATIONS being carried on in San Gabriel Canyon near Los Angeles in connection with the construction of the San Gabriel No. 1 flood-control dam, extensive trucking is necessary in hauling large quantities of heavy material and dumping over embankments. In new fill at the edge of such dumps there is always some risk of overbalancing a truck as it tilts a heavy load and the rear wheels sink into the soft material under the increased load concentrated upon them. Settlement of the rear wheels brings the truck's center of gravity still nearer to the danger point. After a few accidents from this cause a device was tried out which is reported to have been successful in safeguarding the trucks against overturning while dumping.

This device consists of a dolly or pair of wheels on an axle attached to the truck and trailing along under the rear end of the truck body. Between the dolly axle and the rear of the truck body is a mechanism consisting of a piston in a dashpot. The shaft of the piston is connected to the truck body, and the cylinder is attached to the dolly axle. Length of the shaft is such that when the truck body is horizontal the dolly wheels are raised from the ground a few inches and hence do not come in contact with the ground while the truck is in transit with body horizontal. When the body is tilted the shaft, and with it the dolly and piston, are lowered until the dolly wheels rest on the ground.

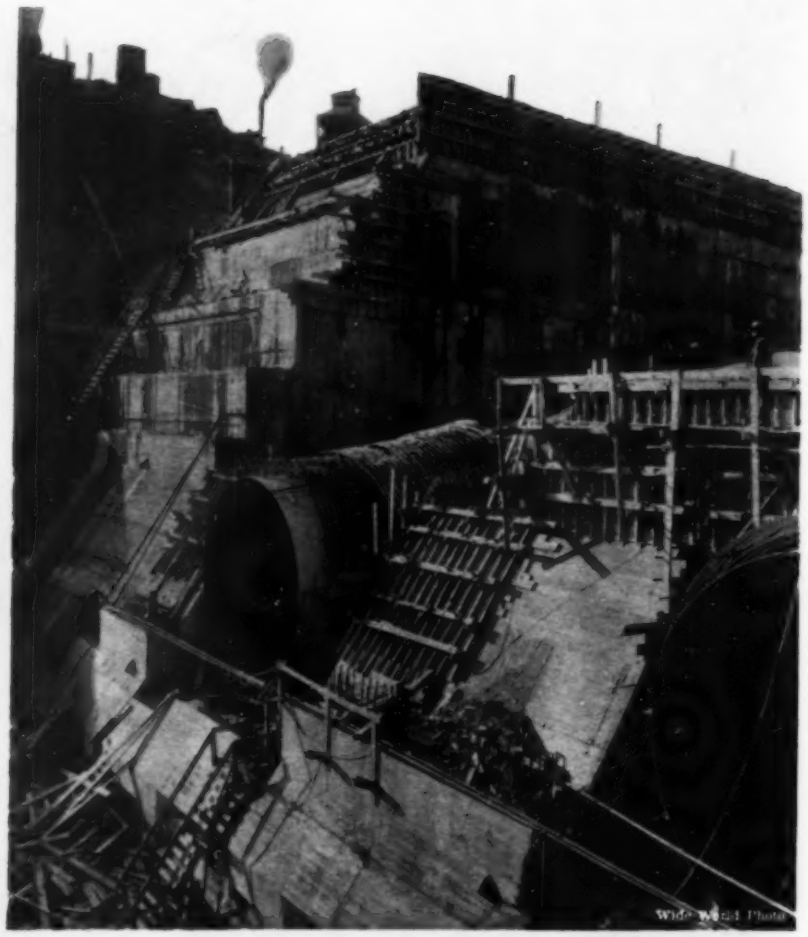
From this point on the piston moves downward in the dashpot. As the entire device weighs about 800 lb., gravity serves to keep the piston always at the upper end of the dashpot until the truck body moves it downward. A spring controlled ball valve in the piston allows oil to flow quickly through a relatively large opening in the piston head when the piston tends to rise toward its upper position, but when the piston tends to move downward toward the lower position the pressure closes the ball valve and the piston can move only as fast as is permitted by the flow of oil around the piston through a small bypass tube leading from the top to the bottom of the cylinder. The rate of flow in the bypass is set at a predetermined amount.

Diameter of the cylinder is about 13 in., and the piston has a stroke of about the same length. The wheels are built up of ½-in. steel plate with solid hubs welded in to give a bearing for each of the two shafts by which the axle is attached to the truck frame. The shafts are formed of two steel angles fastened together by longitudinal welds along their contacting edges, forming a member with a box-shaped cross-section. Each shaft is attached to the rear end of the truck frame by a swivel eye.

Although work on these dollies was done in the mechanical shops of the West Slope Construction Co., contractors on San Gabriel Dam No. 1, credit for the design is given to George Dusler, automotive engineer with the Mack Truck Co.

This Month's

"NEWS REEL"



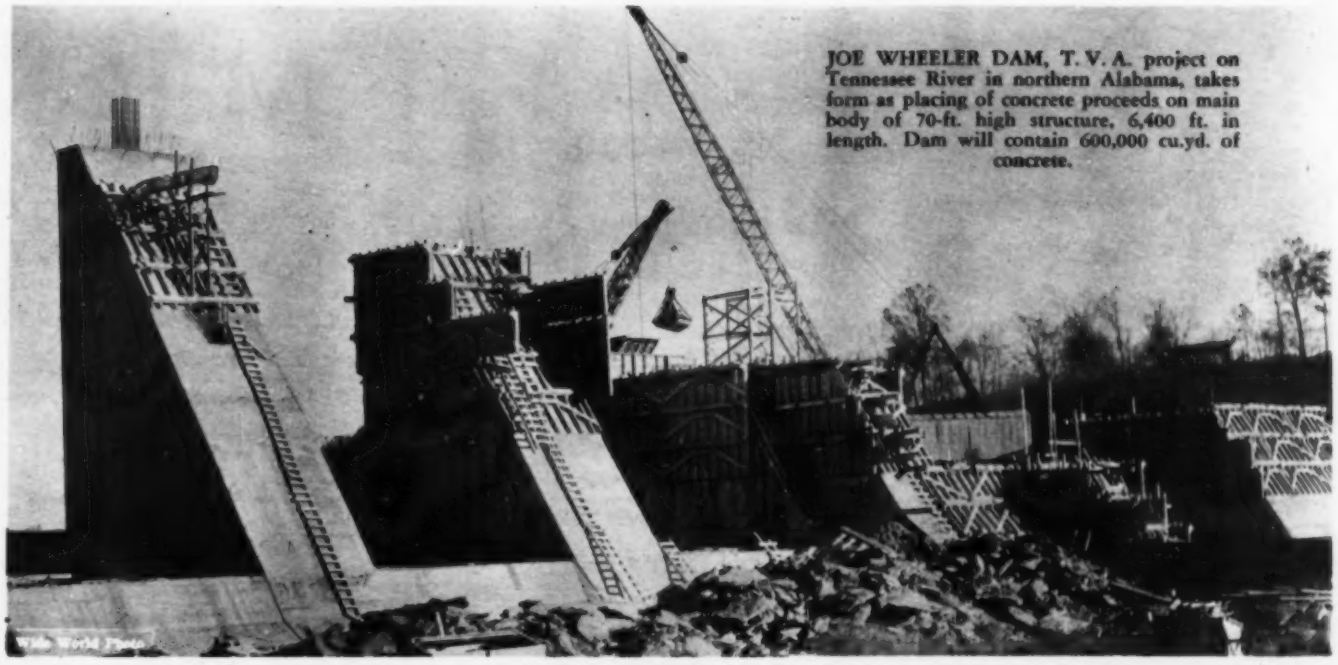
PENSTOCK PIPE of welded steel construction, 20 ft. in diameter, is set in place by cableway to deliver water to turbines of power plant at Norris dam, T.V.A. project on Clinch River, Tennessee.

WATER STORAGE BEHIND Boulder Dam begins Feb. 1, 18 months ahead of schedule, when bulkhead gate at upstream portal of diversion tunnel No. 1 on Nevada side, is closed, making beginning of Colorado River regulation and flood control.

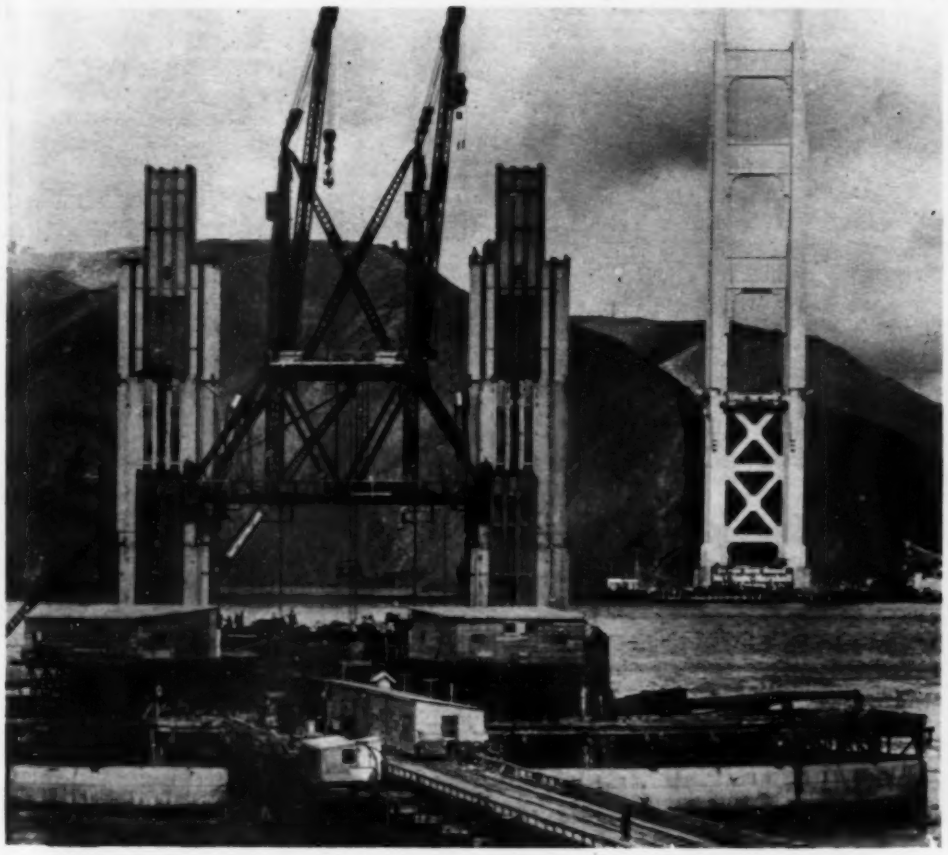
FACE LIFTING OPERATION at Los Angeles County Flood Control District's San Gabriel dam No. 2 after settlement of rock fill caused cracking of concrete facing. Guniting of new connection with cutoff wall (above) precedes replacement of old surface with three-ply timber facing.

CONSTRUCTION LAYOUT *(below and on facing page)* for Grand Coulee dam and power project on Columbia River, Washington, for which Mason-Walsh-Atkinson-Kier Co. is principal contractor. Preliminary operations by six contractors include building of Mason City to house construction personnel, temporary timber trestle across river, excavation of overburden at damsite, railroad lines, highways, water supply and Government bridge. For U. S. Bureau of Reclamation, F. A. Banks, construction engineer, is in charge.

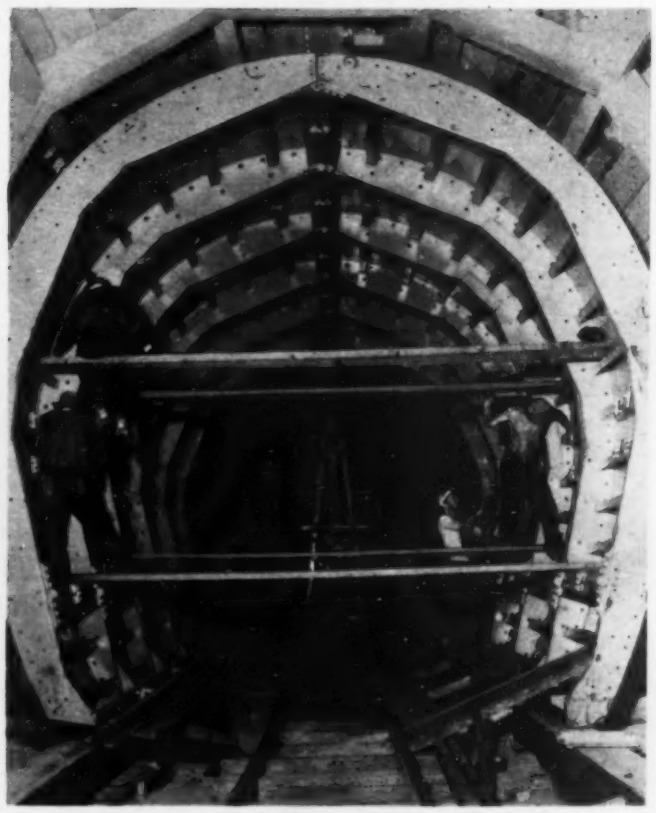
KEY TO PANORAMA: 1. Start of Crick & Kuney Co.'s highway and railroad grading project. 2. Spoil bank from railroad and highway cut at (4). 3. An 86-ft. rock cut by Crick & Kuney Co. 4. Heavy cut on railroad and highway. 5. Toe of slope, start of M.-W.-A.-K. Co. excavation.



JOE WHEELER DAM, T. V. A. project on Tennessee River in northern Alabama, takes form as placing of concrete proceeds on main body of 70-ft. high structure, 6,400 ft. in length. Dam will contain 600,000 cu.yd. of concrete.



STEEL in tower on south pier of Golden Gate bridge, San Francisco, is being erected rapidly, spurred by contest between riveter gangs on two legs of tower. Picture shows Marin tower in background, 4,200 ft. away. In foreground heavy erection cranes are in operation on traveler truss. Concrete fender ring (in foreground), difficult construction job 1,100 ft. out from shore, is founded on rock 107 ft. below water surface.



FIRST CONCRETE TUNNEL LINING for 241-mi. Colorado River aqueduct in California is placed behind 90-ft. section of steel forms in 4,605-ft. long Mecca Pass tunnel No. 3 by Morrison-Knudsen Co. for Metropolitan Water District of Southern California.

KEY TO GRAND COULEE PANORAMA *(continued)*: 6. The 150-ft. railroad tunnel to be driven by M.-W.-A.-K. Co. 7. Fiddle Creek 400,000-cu.yd. fill. 8. Permanent railroad bridge of M.-W.-A.-K. Co. 9. Terminus of railroad beyond screening plant. 10. Contractor's temporary trucking trestle. 11. Office building for M.-W.-A.-K. Co. 12. Mason City's $30,000 mess hall. 13. Screening plant of Western Construction Co. 14. Site of U. S. Government highway bridge. 15. U. S. Government camp.

U.S. Bureau of Reclamation Photo

JOB MANAGEMENT

IN ROAD BUILDING

First of Six Articles Dealing With Factors That Affect Equipment Selection, Operation and Dependability, Production and Cost

By J. L. HARRISON

Senior Highway Engineer, U. S. Bureau of Public Roads, Washington, D. C.

–1–
Daily Costs and the "Work-Dollar"

ANY STUDY of the various aspects of contracting as a business indicates clearly the existence of a great deal of interdependence among them. This is no less true of the management of job construction than of other phases of a contractor's activities. Therefore, though it may sometimes appear that construction proceeds in a quite independent fashion, it may be accepted as a fact of universal applicability that no such condition of independence exists. Indeed, construction could not proceed at all if such matters as financing, purchasing and general planning were not being handled with at least a fair degree of efficiency. In short, construction is affected by a good many things not done in the field and not done by the job superintendent.

Although this is a fact which cannot be overlooked in a general appraisal of the relation of construction management to other phases of the contractor's work, it is desirable, at times, to discuss construction management as though it were a wholly independent operation. Treating it in this way avoids extended discussion of the dependence of job management on decisions in other fields which, after all, is quite proper, for these affect neither the principles nor the practices that are important in it. Little loss, therefore, is involved in their omission from a series of articles on job management.

"This series of articles will assume that in the management of construction the only problems that must be solved are those which develop on the job — that is, the problems of equipment, organization and execution.

Method of Approach — To present this matter in a little different way, this series of articles will assume that in the management of construction the only problems that must be solved are those which develop on the job—that is, the problems of equipment, organization and execution. In a general way this means that the management of construction will be considered from the standpoint of the superintendent who is charged with the responsibility of organizing a working force with which to execute a given undertaking as efficiently and as economically as possible.

There are no materials purchasing problems to be considered, no problems in financing, no problems to be faced in procuring work. The work has been obtained; financial arrangements have been made; materials have been purchased; other details have been or are being given proper attention at the central office. None of these, it will be assumed, now concerns the superintendent whose responsibility *on the job* is quite distinct from his responsibility as *an advisor to the management,* in which capacity he commonly assists in making operating plans, in the selection of equipment and in other important aspects of construction work. On the job, however, his chief responsibility is to execute the work at the lowest cost consistent with the established standards of quality. To him, then, construction is organization for accomplishment and efficiency and the attainment of the lowest cost consistent with the standards of quality with which he must comply.

But if organization offers the approach to low cost, the question is at once raised as to whether, to what extent and how organization affects cost. After that, an inquiry naturally presents itself as to whether any relationships that may exist here can be stated in general terms or whether they involve matters to be considered separately for each job and, therefore, not reducible to rules of other than quite limited application.

"Work-Dollar" Defined — The answer to these questions may be approached by various routes, but the writer prefers to approach a statement of the relation that exists between organization and efficiency through the dogma that the measure of efficiency and of cost in construction is the amount of production that is obtained per "work-dollar" expended. This work-dollar requires a word of explanation. It is the dollar spent in accomplishing the work which must be done *on the job* in producing the finished product. Obviously this work-dollar includes the cost of labor and of job supervision. It also includes equipment charges. It does not include the cost of materials. It does not include such incidental items as getting on to the

"When certain specific equipment is sent to a job, the rate at which equipment expense will be generated is fixed."
"In the management of construction, the objective is greatest possible production per work-dollar expended."

The Author — J. L. HARRISON was born in Freeport, Ill., studied civil engineering at University of Nebraska and was graduated in 1908. He was appointed to the Insular Civil Service for assignment to the Bureau of Public Works of the Philippine Islands. He served there for 9 years in direct contact with construction methods and practices. The engineers in responsible charge of the various provinces were required to bid in competition with the contractors and handle a considerable amount of construction work on which the same problems contractors face in organizing and equipping their operations had to be faced and solved.

Mr. Harrison returned to the United States in 1917 and since then has been attached to the staff of the U.S. Bureau of Public Roads in various capacities. In 1923 the Bureau began an intensive examination of construction methods and practices which were directed toward an analysis of efficiency in construction management. A good deal of this work was done under the author's immediate supervision.

job, insurance, bonds, etc. Neither does it include losses due to delays or other miscellaneous items of expense which develop on every job, but which are not occasioned by specific effort to convert raw or partially processed materials into a salable finished product. In short, the work-dollar is the dollar spent in performing the necessary work construction involves. For ordinary purposes it includes payments for all labor used on production operations and the total expense generated by the use of equipment on these operations.

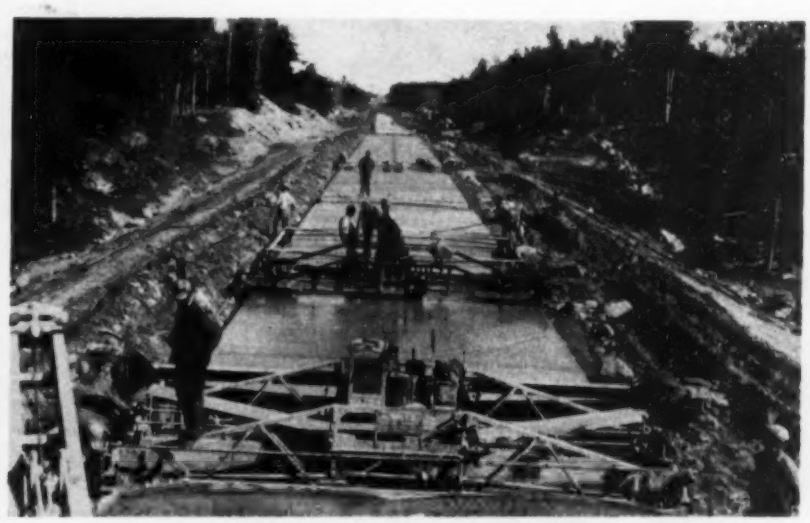
This being the case, the lowest production cost is reached when the largest output per work-dollar expended is obtained. At first thought this may seem to be merely another way of saying that the greatest efficiency is reached when the best production per man employed is had, but upon closer examination it will be found that the two ideas are not quite the same. Construc-

EQUIPMENT is the mainspring of construction to-day. Here is a sand and gravel plant with hoist and scraper bucket, belt conveyors, crusher and screens, crawler crane, bins, batching plant and motor trucks.

specific equipment will be sent to the job and that certain operations will be performed by hand labor.

Job Management Factors—Without going further into this matter here it may then be stated as a generally accepted fact that thereafter the job management faces two established facts: (1) That there is a pretty definitely known amount of work to be done; and (2) that certain specific equipment and such labor as may be needed will be furnished with which this work is to be done. We may add to these facts a third and fourth: (3) Once the job is organized and operating normally the daily cost of the labor plus the daily cost of the equipment (operation plus depreciation) will be fairly constant; and (4) the amount produced per day is likely also to be fairly constant, though usually it can be more or less improved by managerial action. This daily output divided by this daily cost

NOT MANY YEARS AGO the finishing of a concrete pavement was a slow, hand-labor process. Its management was a management of men rather than of machines.



TO-DAY'S FINISHING of concrete pavement is largely a matter of machines. This is typical of the change from hand to machine operation that has occurred throughout the highway field.

tion of any sort can be done by hand labor equipped only with hand tools, or by various combinations of labor and machines, and, in some cases, by machines which are so nearly automatic that the element of human labor is all but wholly eliminated. The work-dollar is the dollar spent for performing necessary work and, as construction is handled in this country, this work-dollar always includes a fraction for labor and a fraction for equipment.

Job management is pretty completely centered on this work-dollar—on making it buy as much production as possible. Job management, as here considered, has nothing much to do with the cost of materials and, outside of the field of carelessness cannot, short of sheer dishonesty, affect cost to any great extent here. This same is true of such costs as getting on to the job, of the cost of bonds, insurance, overhead, etc. In short, it is only in the matter of the amount of work performed per work-dollar spent that job management can much affect cost. For this reason the attention of job management is properly focused on the productivity of the work-dollar—that is, on those things which influence the amount of work accomplished per work-dollar expended.

Preliminary Planning—As a preliminary to initiating operations on any job there should always be and, in practice, usually is some consideration of the manner in which the work is to be handled—in particular, some consideration of the operations which are to be mechanized and of the operations which are to be executed on a hand-labor basis. In considering these matters the kind of mechanization to employ will also receive attention. Out of these discussions there will come a series of decisions. This operation will be continued on a hand-labor basis, that one will be mechanized. Here an old machine will be used—there a new one which has demonstrable advantages. The result of these decisions, in which the job superintendent usually has an influential voice, is a conclusion that certain gives the production per work-dollar spent which is the item on which the interest of job management properly centers. For this reason a little study of this relationship is worth while.

"Equipment is, today, the backbone of the construction organization. We have passed out of the period when equipment helped labor to do the work and into a period in which labor helps and guides the equipment which does the work. A radical change in the conception of job management results. It ceases to be primarily a management of men; it becomes a management of machines."

Such a study reveals several facts. Of the two elements in daily cost, equipment cost and labor cost, the first, which is the daily cost generated by the equipment, is pretty rigidly fixed when the equipment for the job is selected. Both operating expense and depreciation accrue at a relatively constant rate. Over this rate the job management has little or no control. We may, therefore, dismiss this aspect of equipment as of no great moment from the standpoint of job management except, as will develop later, that job management may be able to obtain changes in the amount or the style of equipment supplied to the job which are required in order more adequately to tool specific operations.

Parenthetically, it may be added that this should not be interpreted as an implication that the selection of the equip-

ment is of no consequence. On the contrary, it of much consequence. The point here is merely that when certain specific equipment is sent to a job, the rate at which equipment expense will be generated is fixed. The selection of this equipment determine the costs the equipment will develop, which in turn establishes the equipment element in the work-dollar. The decision as to what equipment ought to be used is, therefore, important, for it may have a good deal of effect on the production which can be had per work-dollar expended. However, as this decision usually is made before the job is started, its effect is not one the job management can be expected to control except, as already noted, when the job management can secure changes in the amount or the style of the equipment assigned to the job.

The second point our examination of the daily cost-daily production relationship reveals is that, while the labor fraction of the daily cost is established by the number of men employed and the rates at which they are paid and so is fairly constant once a job is organized, there is some room here for managerial discretion in the design of the organization. There may also be some room for discretion in the matter of rates of pay.

MOVING EARTH BY HAND LABOR to cover slab for curing. In half a day an elevating grader would move more material than this gang could handle in a week.

SUBGRADING BY HAND *(right)* took a lot of labor and time. HORSE-DRAWN FRESNOS *(below)* marked the next step in doing the work more quickly and cheaply.

The third point this examination develops is that while daily production, like daily labor cost, tends to become relatively uniform, managerial action applied here can quite generally improve production without correspondingly increasing daily cost. In some instances improvement here may be had through a better utilization of the working day. In some instances it must be had by bringing up the production of the principal producing unit—that is, the equipment unit around which the organization is built. In some cases a better balance is required as between the various subsidiary operations.

Flexible Factors—As a result of this brief statement of the relation of production to the work-dollars spent it is apparent that the management of construction is based on one relatively fixed fact—a pretty definite equipment set-up—and that it should give primary attention to five somewhat flexible conditions: (1) Number of men employed; (2) rates at which these men are paid; (3) utilization of working time; (4) rate at which the principal producing unit is operated; (5) internal balance of the working organization.

Bearing in mind that in the management of construction the objective is the greatest possible production per work-dollar expended, the analysis made above suggests that in addition to the relatively fixed daily equipment cost, the daily expense a job will develop in the work field depends on the number of men employed and the wages paid to them. The total cost of executing the work will depend on the period during which this expense is incurred—that is, on the daily rate of production.

Wage Rates and Labor—The matter of wage rates may be dismissed from further consideration here for the reason that these rates are largely governed by local conditions, the prevailing wage scales and company policy. In some cases, wage rates are nominally set by the job management but more generally they are established by the central office on the basis of its examination of local conditions or at least are governed by general central office policy. For this reason job management usually has little, if any, opportunity to affect total cost by the decisions it is permitted to make in this field. This being the case, the management of the daily cost of operation is reduced in theory, as it is in practice, to decisions affecting the proper number of men employed.

Where a job is fully mechanized there is little opportunity for error in judgment as to how many men are required. On the other hand, on those jobs which are only partially mechanized, it is rather easy to over-man operations handled on a hand-labor basis. All operations must, of necessity, be kept in balance. If a hand-labor operation lags, the tendency is to add labor. Often this is not the correct solution. It is a wise superintendent, indeed, who knows his work so well that he can tell exactly how many men each hand labor operation really requires and, knowing it, can keep the operation on schedule with this number of men.

No road construction operation, and, for that matter, no other type of construction operation, involves merely a number of men. Their proper placement, training, supervision and control are a necessary incident to successful operation. Still, without regard to this, it should be obvious that, once the

TRACTOR-HAULED RIPPER prepares old highway to serve as base for new pavement.

proper number of men is employed, the labor fraction of the work-dollar is pretty definitely fixed and remains fixed as long as that number of men is employed. This is without any regard whatsoever to whether a great deal of work is done per day or only a very little, for men cannot be added to or subtracted from a construction job at will or even to compensate for fluctuations in the rate of production. In short, the daily expenditure side of construction management presents few problems other than such as may be involved in the determination of the proper number of men to employ on each operation. These are not, perhaps, simple problems, but neither are they problems of great complexity.

To summarize these aspects of construction management: The daily cost which the equipment will generate is

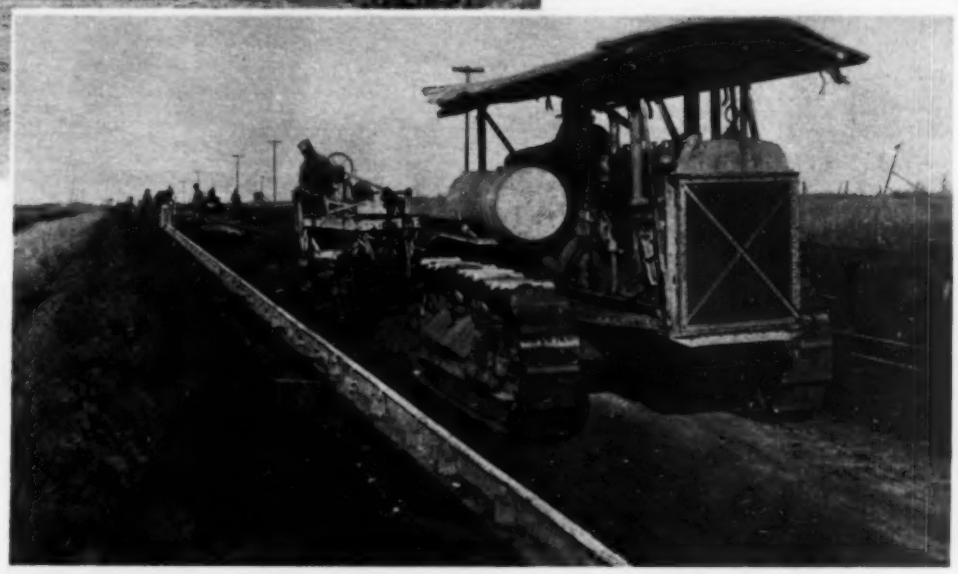
"Once the job is organized and operating normally, the daily cost of labor plus the daily cost of equipment (operation plus depreciation) will be fairly constant."

fairly definitely fixed when the equipment for the job is selected and cannot be materially changed except by the addition or the subtraction of specific equipment units. The labor cost is fixed by the number of men employed and the wages they are paid. Thereafter, the composition of the work-dollar is pretty definitely fixed as is the rate per day at which these work-dollars will be expended. But if this is the case, and the greatest possible production per work-dollar expended is the objective, it follows quite logically that managerial attention must then center on what, by way of production, these work-dollars can be made to buy.

It has already been noted that the work-dollar is a combination of equipment expense and labor expense. The fraction of each in this work-dollar varies from job to job, but during the last 25 years the importance of the equipment expense fraction has increased steadily. This should indicate to those who are willing to give the matter critical attention that, by this process, equipment and its proper use have been made the dominant problems in the management of construction. To put the matter bluntly, in the highway field in particular but perhaps almost equally in at least a good many other fields, equipment is today the backbone of the construction organization. We have passed out of the period when equipment helped labor to do the work and into a period in which labor helps and guides the equipment which does the work. A radical change in the conception of job management results. It ceases to be primarily a management of men. It becomes a management of machines. The performance of the equipment is dominant. The performance of the men tends to become incidental. The meaning of these facts and their relation to job management will be discussed in the second chapter of this series.

"Where a job is fully mechanized, there is little opportunity for error in judgment as to how many men are required. On the other hand, on those jobs which are only partially mechanized, it is rather easy to over-man operations handled on a hand-labor basis."

SELF-POWERED GRADER *(below)* is effective earth-moving machine on road work. Caterpillar unit is operated by diesel engine through tandem drive to dual-tired wheels.



BETWEEN FORMS *(right)* heavy equipment, in form of tractor-hauled grader, prepares surface for fine grading.

SPECIAL MACHINE riding on forms is designed solely to handle subgrading operation, formerly a hand labor job.

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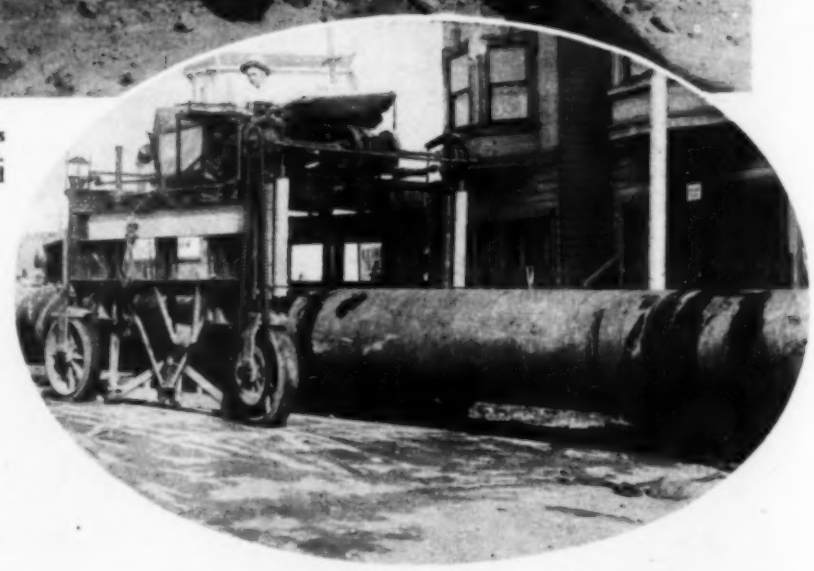
NEXT MONTH—Continuing this series on Job Management, Mr Harrison will discuss in the April issue, "Factors Governing High Production."

West Coast Builds New Water Lines of

ARC-WELDED PIPE

WELDED BELL AND SPIGOT JOINT *(left)* of 36-in. water line. After inspection, joint is coated with tar and heavily cemented.

7-MI. PIPE LINE *(right)* for East Bay Municipal Utility District, running from San Pablo filter plant to Richmond, Calif., is fabricated by arc welding in shop and field.



LUMBER CARRIER *(right)* transports 60-ft. lengths of reconditioned 44-in. pipe for portion of University Mound 6,400-ft. line.

TWO NEW West Coast water pipe lines, one a 7-mi. fresh-water transmission main for the East Bay Municipal Utility District, of Oakland, Calif., and the other an 8,900-ft. supply line for the San Francisco Water Department, are being built by arc welding. A third arc-welded line in Berkeley, Calif., is re-using some pipe from an old temporary main.

East Bay Line—Constructed of 36-in. mild steel pipe of ¼-in. wall thickness, the East Bay main is designed to operate under a pressure of approximately 160 lb. per square inch. All longitudinal seams were welded automatically by the fabricator, the Steel Tank and Pipe Co. of California. The first fast bead used in fabricating the pipe was put on the inside by hand to serve as a sealing bead and to aid final welding under the high heats of the automatic machine. Two lengths of pipe 15 ft. long were welded together manually by bell-and-spigot joints to form 30-ft. sections. Elbows were made up in the shop and manually welded, using 3/16-in. and ¼-in. coated electrodes.

Field Welding—In welding the pipe in the field approximately three beads are used. In some instances, on the overhead welding, the last weaving bead (about 1 in. wide) is carried clear to the bottom of the pipe. In other cases, single beads are run for about 17 in. on the bottom. Complete welding of the joint is done at the rate of about 1 in. per minute.

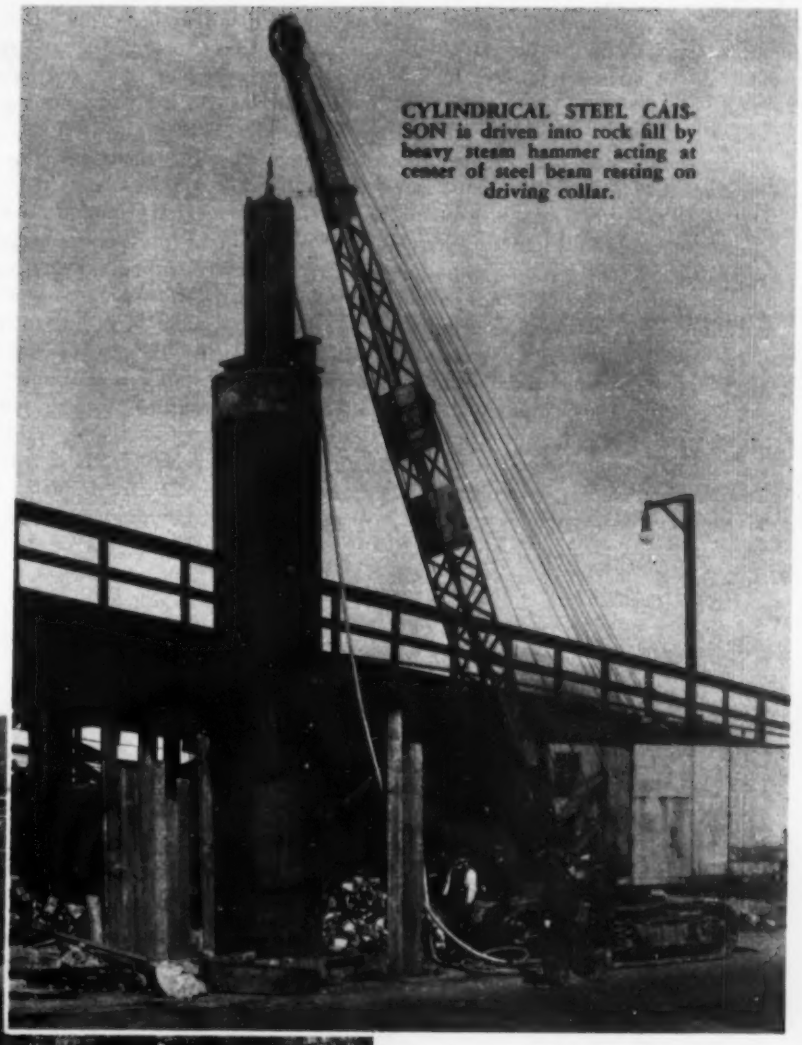
Lincoln gasoline-engine-driven welding sets used on this work are equipped with time-delay idling devices which maintain steady welding current and reduce fuel costs by slowing down the engine about 30 sec. after the arc is broken. The engine runs at high speed only when the operator is welding. Remote control devices permit the operators to control current at the work without walking to and from the generators. With this device, which is mounted on the welder, the operator raises or lowers welding current merely by tapping the electrode on the work.

54-in. Supply Line—The 8,900-ft. line for the San Francisco Water Department is fabricated in the field by arc welding bell-and-spigot joints of 54-in. pipe. H. C. Price, Inc., of Bartlesville, Oklahoma, is the contractor.

Old Pipe Re-Used—About 2,200 ft. of the new University Mound line, in Berkeley, Calif., is constructed of old pipe 44 in. in diameter and 5/16 in. thick originally laid with bell-and-spigot joints as a temporary part of a water system. In relaying the pipe, the belled ends are cut off, making a plain butt joint with no bevel and an average gap of ⅛ in. between the ends. Cassidy & Gratta, the contractors, run two beads of 3/16-in. electrode on the outside and one bead on the inside, using a total of approximately 5½ lb. of electrode per joint.

On all three lines, the builders use Lincoln welding equipment.

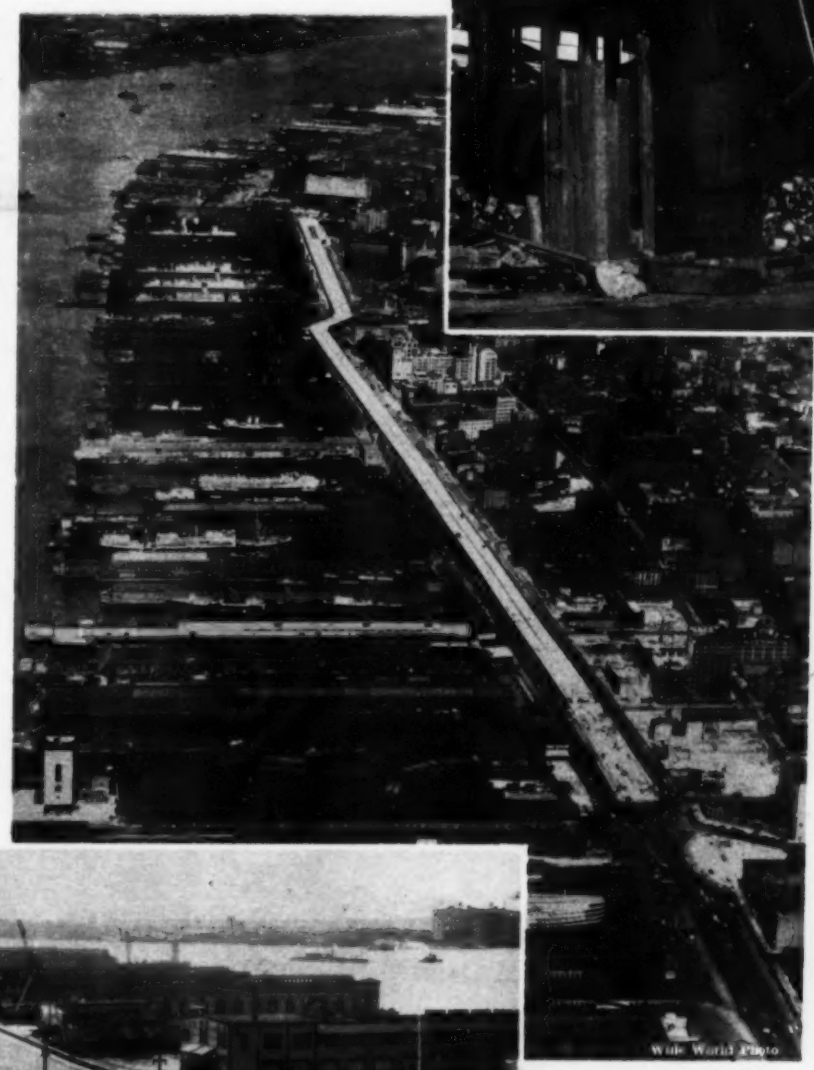
Open Steel CAISSONS *Driven Through Water-Bearing Rock Fill*



CYLINDRICAL STEEL CAISSON is driven into rock fill by heavy steam hammer acting at center of steel beam resting on driving collar.

BY BORING and blasting around the inside circumference of circular steel caissons below the cutting edges, the Necaro Co., Inc., of Brooklyn, foundation contractor on a section of the West Side elevated highway, New York City, drove steel cylinders through water-bearing rock and timber fill to a layer of semi-pervious material and ultimately to bedrock at depths varying from 40 to 90 ft. This operation is believed to constitute the first attempt alongside the New York City waterfront to drive steel caissons to great depths without the use of compressed air. On a small percentage of the caissons, driven in the most difficult ground, air had to be applied before driving was completed.

Soil conditions made it impossible to drive any type of foundation piling on this section of the highway, as had been done on other sections. Two options were open to the contractor. One called for spiral-hooped concrete piers without shells, and the other provided for steel shells which took the place of the spiral reinforcement and thereby re-reduced the diameter of the pier by 6 in. The latter option was preferred by the successful bidder. Of the several possible methods of construction the contractor selected open caissons as more practicable than either pneumatic caissons or steel sheetpiling. Electric centrifugal caisson pumps of improved design were used to keep the holes dry while they were being excavated.



Wide World Photo

ELEVATED ROADWAY *(right)* takes passenger vehicles off street and provides uninterrupted traffic flow between upper and lower Manhattan. Central ramp is placed in widened structure at 40th St.

WEST SIDE ELEVATED PUBLIC HIGHWAY parallels Hudson River from Canal St. north. First section completed extends along West St. from Canal to West 23rd St.

Extent of Work — The foundation contract for division 3, Sec. 1, of the Borough of Manhattan's West Side highway called for the construction of 105 caisson piers to support the elevated roadway and ramp approaches. Division 3 extends from 38th to 48th Sts. on 12th Ave. and Marginal St. Above 42nd St., the two latter streets form a single broad thoroughfare extending from the 12th Ave. curb on the east to the docks, piers and bulkheads of the riverfront on the west. The entire area consists of made ground built up 40 ft. from riverbed by dumping hard rock spoil from subway excavations and other conglomerate fill material.

From 40th to 48th Sts., the elevated highway is carried on three-column bents spaced 84 ft., c. to c., with the columns of each bent spaced 34 ft. on centers. Between 38th and 40th Sts., the structure is widened to accommodate a central approach ramp with two-way traffic, and the bents consist of four columns spaced 28 ft., c. to c. Caisson piers supporting the columns are 4½, 5 and 5½ ft. in diameter.

Contractor's Plant—As the contractor planned to drive the steel caissons

with air hammers and to excavate and remove spoil with air-driven equipment, it was necessary to have a compressor plant of large capacity. A stationary plant was selected as more economical than a large number of portable units. As installed, the compressor plant consisted of two machines mounted on concrete foundations and driven by 100-hp. electric motors, each unit capable of delivering 600 cu.ft. of air per minute, and two smaller compressors of 360-cu.ft. capacity, giving a total potential output for the plant of nearly 1,900 cu.ft. per minute. A 6-in. main extending from the plant throughout the length of the job was equipped with 2-in. outlets at convenient intervals to supply the hammers and other pneumatic equipment. Two McKiernan-Terry 9B2 hammers and one 11B2 hammer were used to drive the caissons. Air hoists running on trolley beams raised the muck buckets to the tops of the caissons, where the operators dumped the spoil in piles to be picked up by a crane.

To handle equipment and materials on the project the contractor used three gasoline crawler cranes, three truck cranes, and three tractors equipped with booms. The cranes picked up and set the steel caisson sections, handled the air hammers, and loaded the spoil. For this last service, the cranes ordinarily operated clamshell buckets to gather up the muck and place it in hopper-body end-dump trucks which deposited the spoil in a fill alongside the job.

Caisson Pumps—Eight Humdinger vertical self-priming caisson pumps facilitated the dewatering of the caissons during the sinking operations. Each pump was suspended out of the way in a caisson, 6 to 8 ft. above the head of the man at the bottom, with only a 3-in. suction hose and strainer, which could be moved freely to any desired spot. A 3-in. discharge hose conducted water to the surface. As the pump occupied a space only 17x22 in. in a caisson, it left ample space for raising and lowering spoil buckets and tools.

An extremely fast priming and repriming action by the pumps proved a great advantage without which a dry bottom and satisfactory progress would have been impossible, according to the general contractor. Because of widely varying water conditions encountered in different caissons, as well as great variations in the same caisson, and because of the unusual depth of some holes, the pumps were designed to pump all water from minimum seepage to capacities of 300 g.p.m. at heads up to 120 ft.

Driving Caissons—Steel caisson cylinders were made up by the McClintic-Marshall Corp. in 30-ft. sections of ⅜-in. steel plate with two butt-welded longitudinal joints. An inside sleeve coupling was riveted to the top of each section to permit bolting of the following section. To protect the top of the caisson in driving a heavy welded cast-steel collar was placed on top of the cylinder and was held in place by the inside sleeve.

A single 9B2 hammer drove the first 30-ft. section of steel caisson, two 9B2 hammers drove the second section, and a single 11B2 hammer completed the driving where a third section was required. When single hammers were used, they operated at the center of a driving saddle (a short piece of heavy steel girder) placed across the top of the steel driving collar, as illustrated by an accompanying photograph. When utilizing two hammers, the contractor set them directly on the driving collar and operated them simultaneously through independent hose connections. No attempt was made to synchronize the blows, as all previous efforts of the contractor to obtain synchronization on other jobs had proved futile.

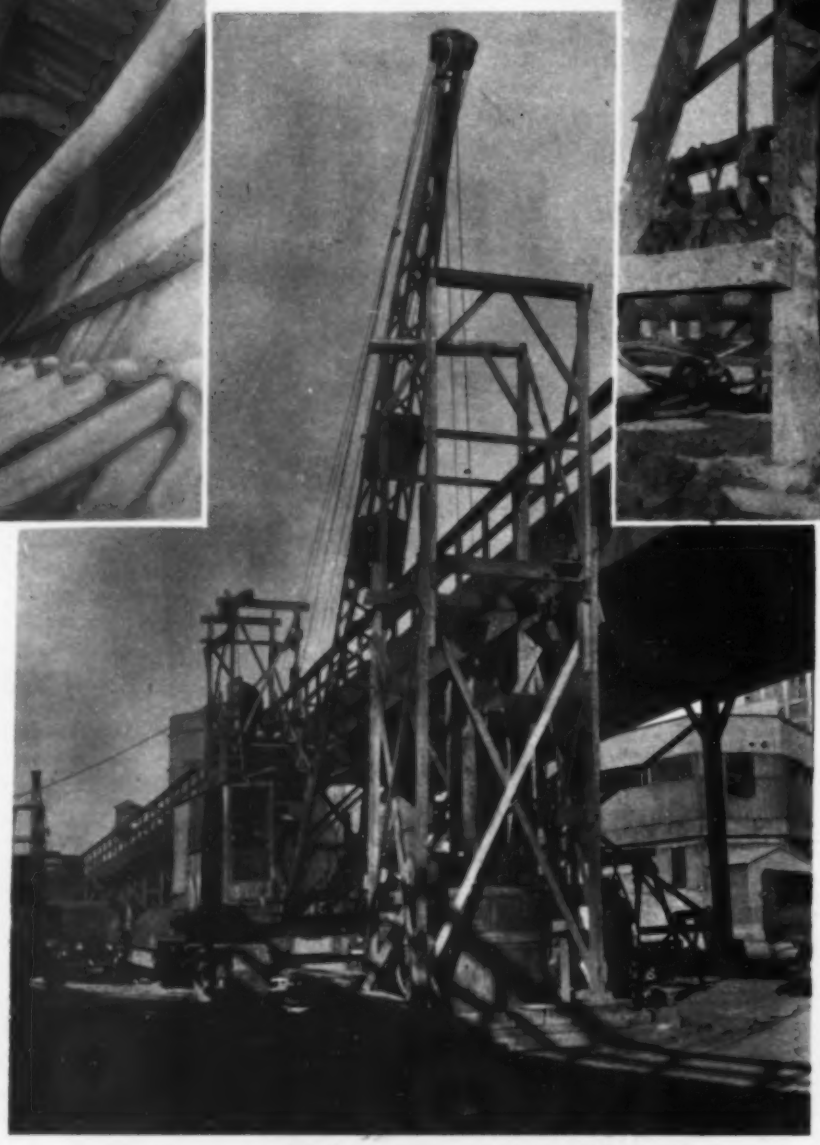
Driving procedure in general consisted of the following steps: (1) Excavate and sheet a pit to the permissible depth of 8 or 10 ft.; (2) clean the bottom of the pit and make it ready to receive the caisson; (3) place the caisson in the hole with a crane; (4) if soil conditions permit, proceed to drive cautiously, plumbing the cylinder every 3 ft., or more often where necessary; (5) as caisson refuses to drive, erect timber tower to support working platform and begin drilling and blasting operations; (6) repeat blasting and driving until caisson penetrates to plastic material below rock fill; and (7) continue driving and excavating to bedrock.

From ten to twenty blasts were required in about 50 per cent of the caissons. These caissons in general refused to drive after they had penetrated 5 to 10 ft. below the bottom of the sheeted pit, or about 15 ft. below the street surface. When a caisson refused to drive, the contractor erected a working platform and set up a drilling outfit to sink wash borings inside the circumference of the cylinder. Prior to setting up the drill, workmen excavated inside the caisson to as great a depth as possible to reduce the amount of drilling required.

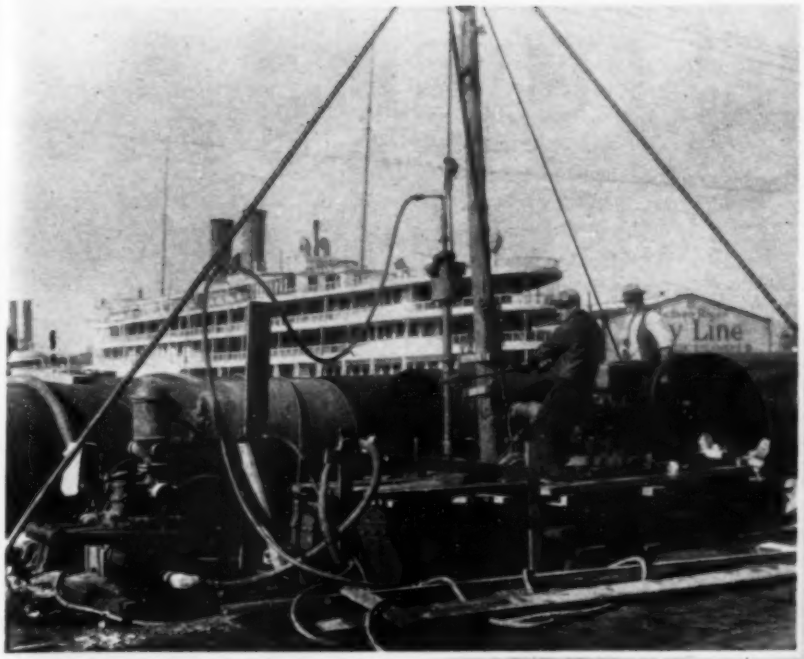
Drilling and Blasting—Wash borings 2½ in. in diameter were drilled under subcontract by the Giles Drilling

FIRST 30-FT. SECTION *(left)* of steel caisson is driven below bottom of sheeted pit and is excavated by hand.

AIR HOIST *(right)* on trolley beam raises muck bucket to surface and dumps spoil for rehandling by crane.



TIMBER TOWERS erected around projecting shells of caissons driven to refusal support working platforms used in drilling and excavating. Hammer resting on driving assembly is putting down caisson in foreground following blasting operations.



DRILLING OUTFIT ordinarily used to make wash borings sinks holes for blasting around inner circumference of caisson. Annular weight is raised and dropped repeatedly on shank of drill stem while man with wrench turns stem.

Corp., of New York City, which operated four drilling outfits on the job. Power for each of the drill rigs was supplied by a gasoline winch. One man manipulated a hemp rope at the winch to raise and drop an annular weight on the shank of the drill stem while a second man with a chain pipe wrench turned the drill stem through about 90 deg. between blows. To penetrate large boulders encountered in some holes, the subcontractor kept on the job a rotary drilling outfit which used shot as the cutting medium.

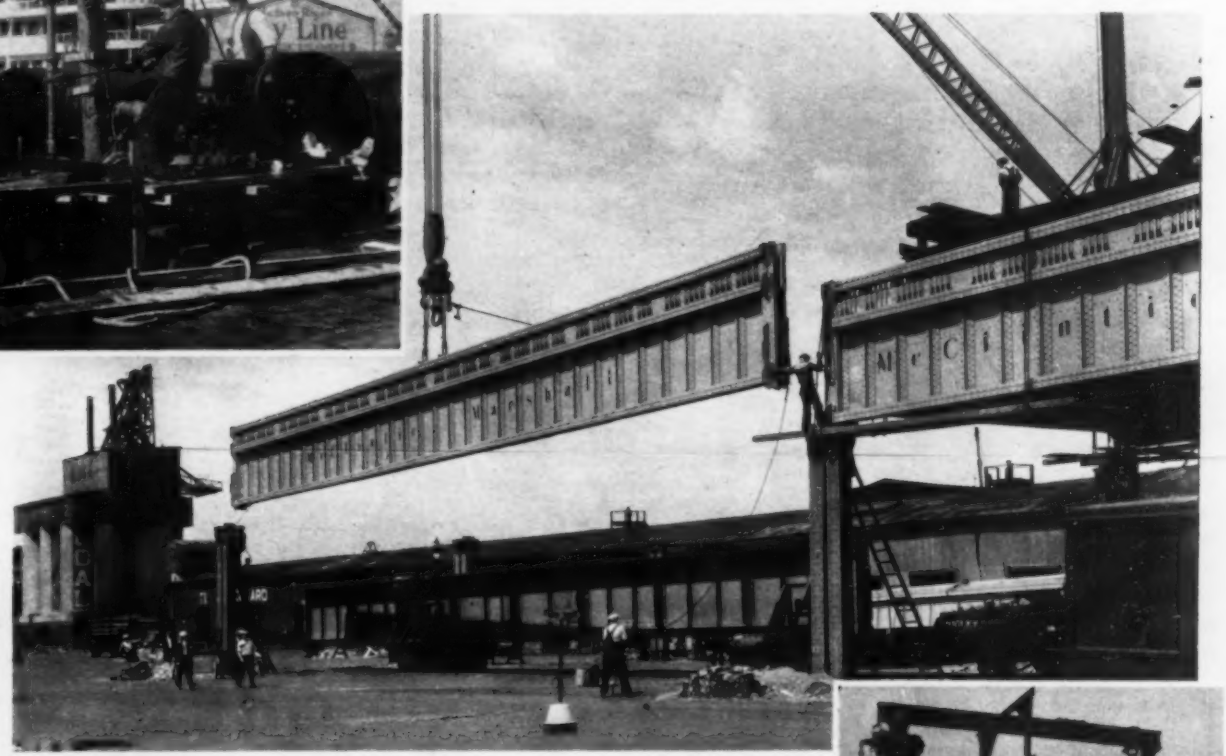
Wash borings were drilled inside the caisson at quarter points around the perimeter, or at eighth points if necessary. Depending upon the depth of the bottom of the caisson and the distance to go to the plastic material, blasts were made 6 to 10 ft. or more in advance of the caisson. Sometimes it was necessary to set a templet in the bottom of a sheeted pit and drill and blast inside this guide before placing and starting to drive the first section of steel caisson. In cases of this kind and also in caissons which refused to drive after penetrating only a short distance, the contractor restricted the drilling to 5 or 6 ft. below the bottom of the steel cylinders and exercised great care in blasting. On the other hand, if the bottom of the caisson was within 10 or 12 ft. of the layer of compressed river mud, the driller sank holes to this stratum before blasting.

An average blast consisted of six or seven sticks of 40 per cent gelatin dynamite. After placing the charge in the bottom of the hole, the drill stem was raised 5 or 6 ft. before the dynamite was exploded. Occasionally it was necessary to drill and blast a second time at the same level before driving could be resumed successfully. At each stage of the blasting and driving operations, the interior of the caisson was excavated to as great a depth as possible, the caisson pumps being used to remove infiltration during this process.

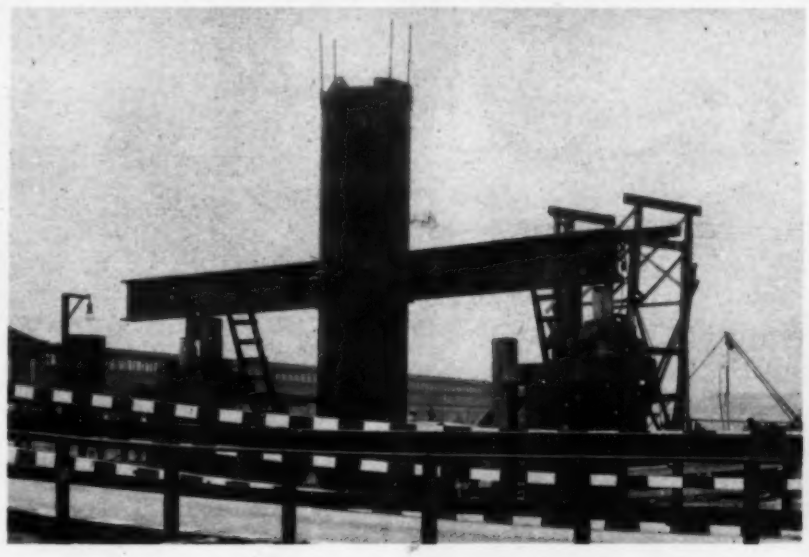
If a caisson ended driving to bedrock in a layer of running sand, causing some fear that the caisson might blow when excavated to the bottom, the contractor jetted a 2-in. pipe to rock inside the steel cylinder and sealed the bottom of the caisson with cement grout by forcing about 2 yd. of this material through the pipe with a high-pressure grouting machine. Two grouting machines were kept on the job for this purpose.

Progress—About 8 months sufficed to drive the 105 caissons included in the contract, having an estimated total length of 5,000 lin.ft. In general, 3 days were sufficient for drilling and blasting a caisson which had been driven to refusal. The hard driving in rock fill moved four caissons off center more than the 2-in. tolerance permitted by the specifications. These caissons had to be pulled and driven again.

In one or two instances where a caisson had been driven to great depth before the shell moved out of plumb more than the specifications permitted, it was impractical to pull the steel cylinder. The contractor then resorted to driving an oversize shell inclosing the original caisson, later removing the original shell by burning it out in sections. It was necessary to use compressed air in eight caissons where the ground was filled with cribbing, piling and large-size boulders which made it almost impossible to maintain the caissons in the vertical position required by the severe specifications.



TYPICAL ERECTION METHOD for steel column and girder design of elevated structure from Canal St. to 72nd St. Girders are transported in vertical position on multi-wheel trailer trucks.



HYDRAULIC JACKS acting against steel girder inserted through steel cylinder raise caisson forced out of plumb by hard driving in rock fill.

TROLLEY-HOIST-AND-PLATFORM UNIT installed on top of caisson handles removal of muck from inside shell.

Supervision—H. A. Armstrong, superintendent, who devised the method of driving open caissons through rock fill, directed operations for the Necaro Co., Inc., under the general supervision of J. L. Carey, vice-president. For the Borough of Manhattan, C. M. Pinckney is chief engineer of public works. John O'Rourke, construction engineer, supervised the work for the borough.

HYDRAULIC SLUICING

Moves 300,000 Yd. From Cuts to Fills

DIFFICULT LOCAL TOPOGRAPHY, favorable soil condicions and an ample supply of water suggested hydraulic sluicing to the Lewis & Frisinger Co., of Ann Arbor, Mich., as a feasible and economical method of moving 300,000 cu.yd. of material out of two deep cuts into adjacent fills approaching a new high-level bridge across the South Branch of the Manistee River, near Wellston, Mich., for the Michigan State Highway Department. By pumping water to the top of steep 90-ft. escarpments on both sides of the river, the contractor washes the sandy soil down portable metal flumes into short, high fills connecting the cuts with the bridge abutments. Two power shovels operate in the cuts, one feeding spoil directly into a hopper at the head of the sluiceway and the other loading trucks which dump the material on slopes where pressure streams of water can wash it down into the fill. With three pumps, two ⅞-yd. shovels and six or seven 1½-yd. trucks, the contractor moves earth in this way at an average rate exceeding 1,750 cu.yd. per 10-hr. day. The hydraulic method produces a solidly compacted fill which could be built to an equal degree of consolidation by no other process.

R. N. FRISINGER (left), president, and H. L. FRISINGER, of Lewis & Frisinger Co., inspect bulldozer operations at site of 200,000-yd. fill on west bank.

200,000-YD. CUT ranging up to 34-ft. maximum depth with top width of 361 ft. supplies material for hydraulically placed fill approaching skeleton abutment in background. Metal-flume sections can be seen stacked in foreground.

HOPPER AT HEAD OF FLUME is fed by ⅞-yd. dipper of power shovel. Grid above hopper rejects large boulders, which are saved to be crushed for road metal. Note pressure jet in flume "kicking" material down sluiceway.

Description of Project—A deep, narrow valley with steep banks furnishes the site for the high-level bridge and for the approach fills and cuts connecting the structure with the level plateau on either side of the ravine. In a total project length of 4,150 ft., the bridge accounts for 614 ft. The structure is of deck-truss cantilever design with a 30-ft. concrete roadway 73 ft. above water level. A central span 350 ft. long is made up of two 150-ft. cantilever arms and a 50-ft. suspended span. The anchor arms are 125 ft. long, and the two abutments, of skeleton type, are each 32 ft. in length. A contract for the substructure of the bridge is being executed by the Owen-Ames-Kimball Co., of Grand Rapids, Mich. The Wisconsin Bridge & Iron Co., of Milwaukee, Wis., holds a contract for the steel superstructure, for the final lifts of the concrete skeleton abutments and for the concrete roadway and two 2½-ft. sidewalks.

Subtracting the length of the bridge from the total project length, the distance remaining for cut-and-fill operations is 0.67 mi. More earth is being excavated on this contract section than on 20 mi. of the same highway, route M-55, between the present project and Manistee, Mich. A cut 1,600 ft. long, containing over 200,000 cu.yd. of material, to the west of the bridge, is the largest single cut ever made by the Michigan Highway Department.

A gravel roadway 21 ft. wide, with a 5-in. compacted base and a 3-in. compacted top course, is included in the Lewis & Frisinger contract. Across the river valley the fill has a top width of 52 ft. Through cuts are 86 ft. wide between center lines of ditches, and side-hill cut-and-fill sections are 43 ft. from edge of shoulder to center line of ditch.

Grading sections are divided 2,123 ft. west of the bridge and 1,413 ft. east of it. Of the longer section to the west, about 1,600 ft. is in cut and 520 ft. in fill. The cut ranges up to 34 ft. deep, with a maximum top width at its deepest point of 361 ft., and aggregates 211,418 cu.yd. of excavation. Back slopes are mostly 1 on 3. In the 520-ft. fill section west of the river, the depth of fill for almost 400 ft. is 60 ft. or greater. The fill, with side slopes in general of 1 on 2, requires 206,575 cu.yd. of material exclusive of an 8 per cent computed allowance for shrinkage (16,524 cu.yd.), making a total of 223,099 cu.yd. At both east and west skeleton abutments, the State Highway Department figured the ends of the fills as standing on a 1 on 1½ slope.

In the east grading section (1,413 ft. long), the plans call for 1,260 ft. of cut ranging in depth up to 30 ft., with back slopes of 1 on 2. Excavation amounts to 95,347 cu.yd. The fill, al-

BRIDGE BUILDERS *(left)*. H. F. Mead (in shirtsleeves) directs substructure work for Owen - Ames - Kimball Co. L. B. Henderson is project engineer in charge of bridge for Michigan Highway Department.

gan operations on the west bank, where the large cut had to be made. The substructure contractor carried up the skeleton-type concrete abutment to permit placing of fill around it. Before starting to sluice material the Lewis & Frisinger Co. cut 4-ft. benches in the face of the steep bank to afford lodgement and bond for the fill on this slope.

In the original plant set-up the contractor employed two pumps at the river's edge (a large-capacity low-pressure centrifugal and a small-capacity high-pressure reciprocating unit) and operated one power shovel in the cut. The second shovel arrived at the job a few weeks later, when the work had reached a stage which permitted an additional excavator to be utilized effectively. Water in sufficient volume to wash the excavated material down the flume was supplied by the large-capacity pump. The high-pressure pump furnished a concentrated stream for starting the material on its way and for undercutting banks.

A timber hopper of about 10-cu.yd. capacity to feed the flume was designed by the contractor's superintendent and the project engineer and was built on the job. The flume was made up of 10-ft. sections of 16-gage sheet-iron bent to approximately semicircular shape and reinforced along each end with 2x6-in. timber strips. Until the bank had been sloped to the proper angle to support the flume, these sections rested on trestle bents about 2 ft. high.

To increase the earth-moving capacity of the hydraulic plant, the contractor later added a booster pump at roadway grade to the large-volume line. In the original set-up, a Dean-Hill centrifugal pump at the river's edge supplied 1,000 gal. per minute to a manifold equipped with ten 2½-in. branches at the hopper. These branches supplied water to ten ¾-in. nozzles which wet down the sand and furnished sufficient volume to carry the material down the flume. When the booster pump (a Dean-Hill centrifugal) was installed on the 8-in. line, five of these nozzles were removed from the hopper and were used as kickers along the flume. Occassionally two of these kickers were employed to wash away material dumped down the slope by trucks.

No change was made in the high-pressure system. A Barnes triplex single-stage reciprocating pump with a capacity of 150 g.p.m. forced water

WEST APPROACH FILL AND BRIDGE SUBSTRUCTURE in process of construction at projected crossing of South Branch of Manistee River. Portion of temporary construction trestle erected by Owen-Ames-Kimball Co. appears at left.

though only 150 ft. long, runs to depths approaching 80 ft. With side slopes of 1 on 2 and an end slope of 1 on 1½, the fill calls for 77,468 cu. yd., increased by an 8 per cent shrinkage allowance (6,198 yd.) to a total yardage of 83,666.

Material to be excavated (as verified by the contractor after removing 100,000 yd. from the west cut) consisted of 75 per cent sand and 25 per cent gravel and clay. Large boulders are screened out at the hopper and saved to be crushed for road metal. The rest of the material washes readily down the portable flume and packs into a solid, homogeneous fill.

Method of Construction—By agreement, both the Owen - Ames - Kimball Co. and the Lewis & Frisinger Co. be-

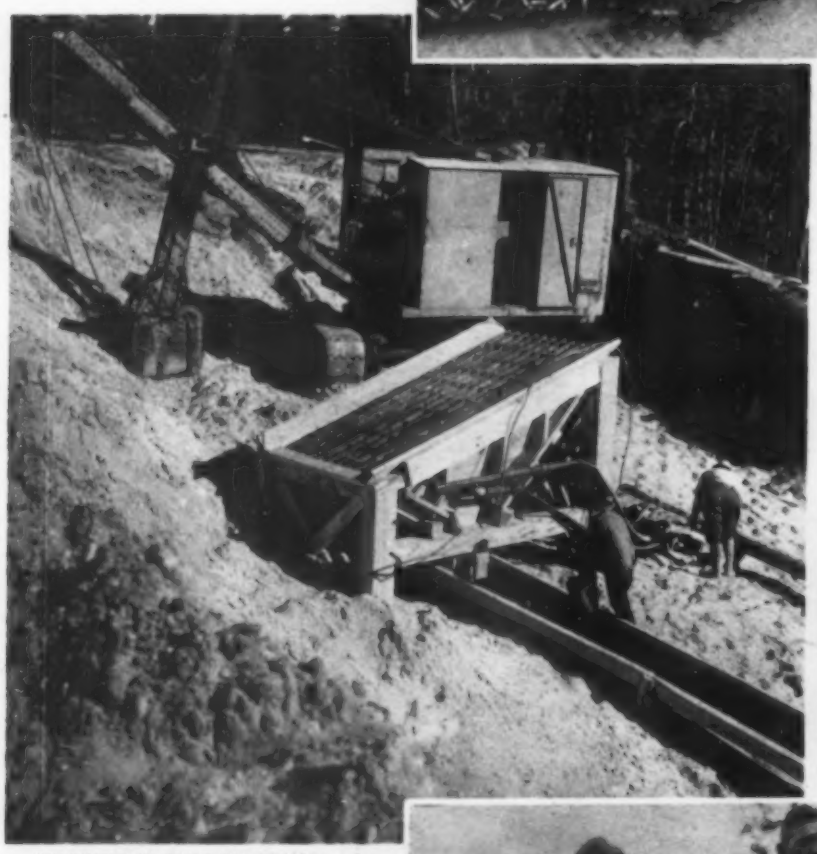
HYDRAULIC FILL for west approach flows down slope from cut at upper level. Tractor-bulldozer, visible to right of skeleton abutment, builds earth dikes to retain fill.

through a 2½-in. pipe to a ¾-in. nozzle which furnished a discharge pressure of 100 lb. per square inch. This high-pressure stream continued to be used to start sand from the hopper and to undercut banks.

For the short level hauls on the plateau at the top of the steep valley slope, the contractor used six or seven V-8 trucks of 1½-yd. capacity. Truck-hauling from the western half of the 1,600-ft. cut to the hydraulic sluicing operation was more economical than to attempt to extend and increase the capacity of the pumping plant and flume. The trucks hauled two ⅞-yd. dipperfuls in each load to a point where the bank was being undercut by the pressure streams below.

Two gasoline shovels of rated ¾-yd. capacity (a Koehring and a Northwest) had their dippers built up with 6-in. steelplate lips to a capacity of ⅞ yd. for the easy digging in the sand cuts.

4-FT. STEPS IN WEST BANK *(left)*, cut with water supplied by road pump, catch sluiced material in first stage of filling operation.



MANIFOLD ON 8-IN. MAIN supplies battery of pressure jets in 10-yd. hopper at head of flume.

PRESSURE STREAMS undercut bank of material dumped by trucks and wash it down slope into fill.

The Northwest unit fed the hopper at the head of the flume, and the Koehring shovel loaded trucks.

After the west approach fill had been more than half completed, the fall became too slight to permit continuance with the hydraulic method. The rest of the fill was placed by trucks. Hydraulic sluicing is to be used for the fill on the east side of the river.

Building Fill — When building fill by the hydraulic method, the flume was laid from the hopper to the end of the cut, where the cut intersected the steep bank of the river valley. The maximum length of flume was about 500 ft. As the material washed down the slope below the flume, it spread out in fan-shaped rivulets over the top of the broad fill, 300 ft. wide at the base. A Caterpillar 60-hp. gasoline tractor equipped with a bulldozer built sand dikes about 4 ft. high around the top of the fill to retain the wet material and to hold the sides of the fill to the desired slopes. Ordinarily the fill was divided roughly along the center line into two halves which were built up in alternate days. On any given day, the wet material would be confined by dikes to one-half the fill, while the tractor would bulldoze another lift of dikes on the half placed during the previous day, which had had an opportunity to drain in the meantime.

Progress—Prior to the addition of the booster pump, the hydraulic plant washed 1,750 cu.yd. of sand per day

AT SITE OF GRADING OPERATIONS *(Left to right)* W. H. Donaldson, rodman; W. M. King, superintendent for Lewis & Frisinger Co.; and J. A. Buck, project engineer for Michigan Highway Department.

After the booster pump increased the volume of water to almost double what it had been previously, the daily average rose to 2,000 yd., which is as much as the two shovels can handle in 10 hr.

Personnel—Murray D. Van Wagoner is Michigan highway commissioner, and Harry C. Coons is deputy commissioner and chief engineer. The grading work at the new Manistee River crossing is under the general supervision of Charles E. Hayes, district engineer, Cadillac, Mich., with J. A. Buck, project engineer, in charge at the site. For the Lewis & Frisinger Co., the contractor, William M. King, superintendent, directs operations.

JOB ODDITIES

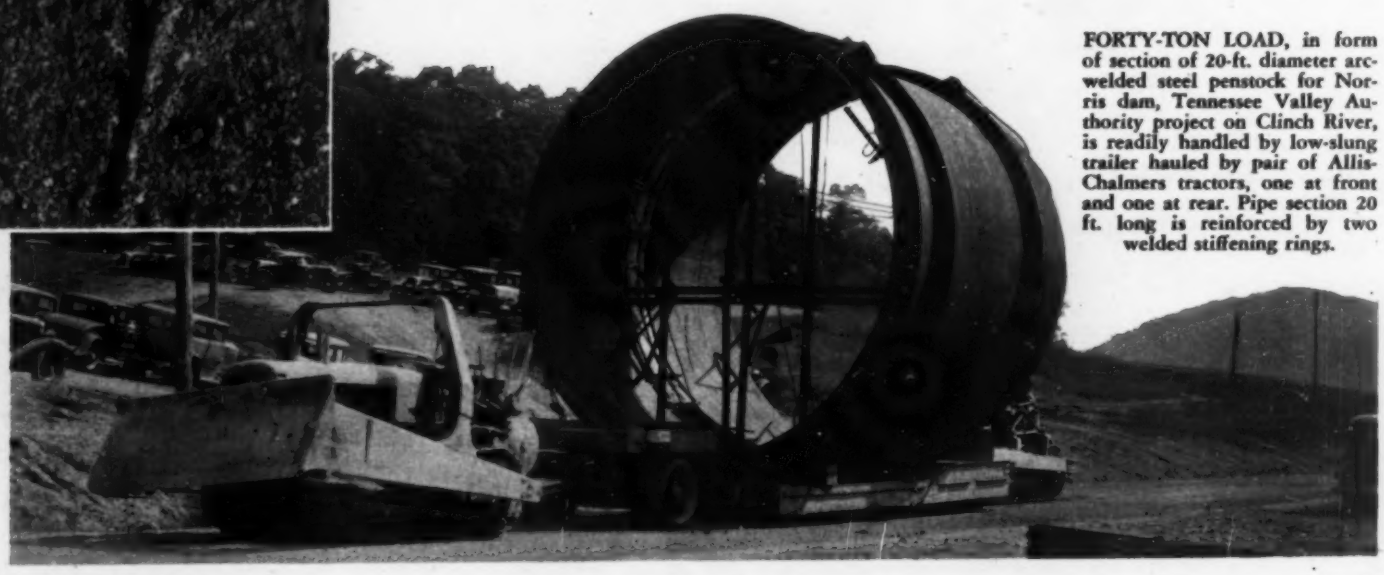
A Monthly Page of
Unusual Features of Construction

DARING YOUNG MEN, but not this time at least, on the dying trapeze. These are sure-footed riggers at work on a boom of one of the big cranes that Six Companies Inc. are using on the U. S. Bureau of Reclamation Boulder Dam project in Black Canyon of the Colorado River.

SAFETY FIRST IN NEW FORM. To guard against being struck from behind by passing motor vehicles this street maintenance worker, applying white paint to curbs and gutters in Kent, England, increases visibility of his own person by hanging large white disks on his trousers.

WEAR RESISTANCE *(above)* of concrete pavement is indicated by imprint of leaf which fell on plastic surface of newly poured slab in year 1916. After more than 18 years the impression of the leaf is still clear cut.

TILTED BRIDGE PIER is result of undermining of foundation of suspension structure at Hidalgo, Texas, by flood of Rio Grande. With stiff-leg derrick and heavy jacks structure was righted and seated on new 50-ft. precast concrete piles by J. W. Beretta Engineers, Inc., of San Antonio, Texas.



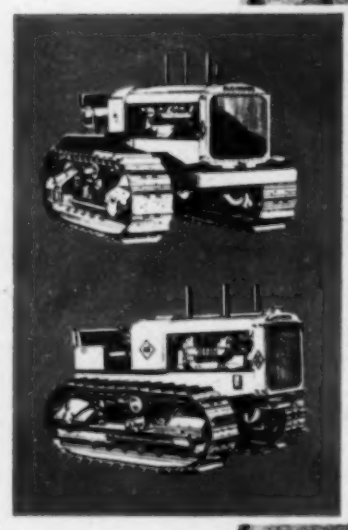
FORTY-TON LOAD, in form of section of 20-ft. diameter arc-welded steel penstock for Norris dam, Tennessee Valley Authority project on Clinch River, is readily handled by low-slung trailer hauled by pair of Allis-Chalmers tractors, one at front and one at rear. Pipe section 20 ft. long is reinforced by two welded stiffening rings.

GET *More* THAN

These are the *facts* that determine Economical Tractor Operation ..

- ✓ **LOW FUEL COST**
- ✓ **LOWER ORIGINAL COST**
- ✓ **LOWER MAINTENANCE**
- ✓ **LESS DEPRECIATION**

THESE are the four big factors in cutting tractor costs. To get one at the expense of the others is no economy. Don't be misled ... before you buy any tractor, find out about lay-ups for repairs ... and condition of the tractor when the job is finished. A-C Oil Tractors operate with less maintenance cost because internal pressures are less than one-third those of the compression type. A-C Oil Tractors are ready to compete on fuel costs and all other costs. Buy the tractor that gives you LOWEST FINAL COST.



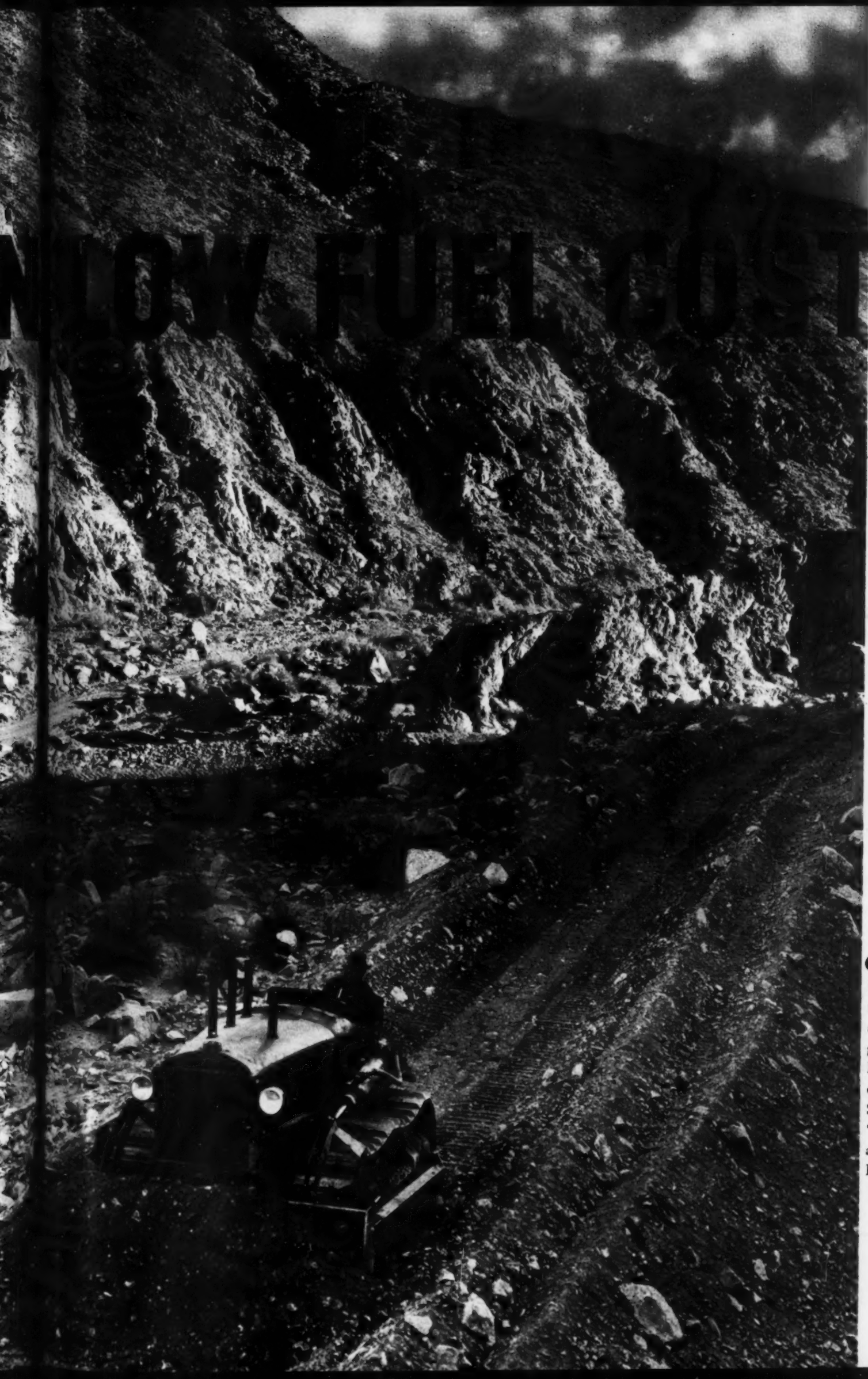
Above—The Model "L-O" Oil Tractor 76 Drawbar H.P.

Below—The Model "K-O" Oil Tractor 48 Drawbar H.P.

A-C OIL TRACTORS GIVE LOWEST FINAL COST!

ALLIS-CHALMERS

TRACTOR DIVISION—MILWAUKEE, U. S. A.

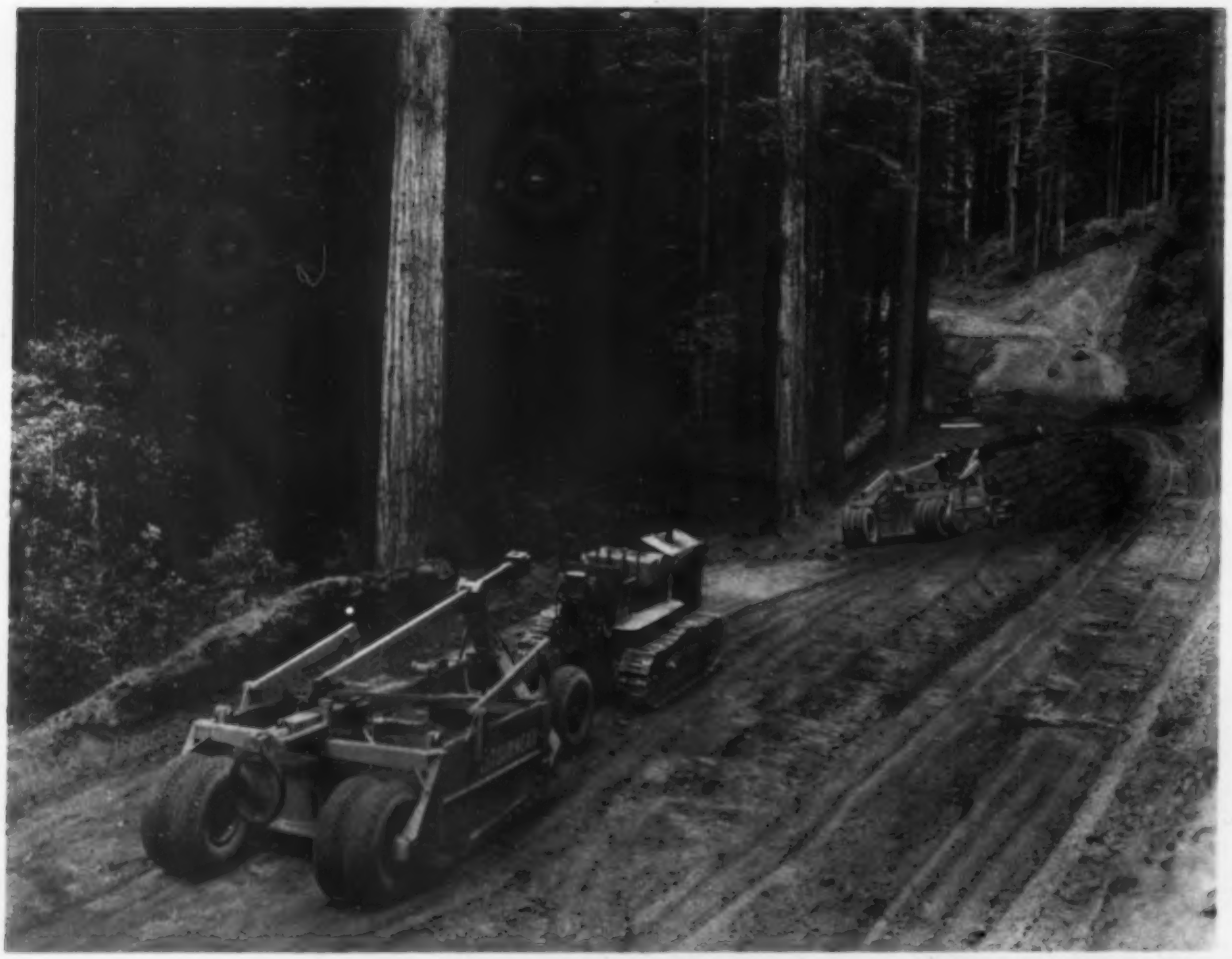


Building a pioneer road for trucking aggregate . . . Fargoe Tunnel section, Metropolitan Aqueduct project in Southern California. "L-O" Oil Tractors are doing this job at Lowest Final Cost.

California Road Builders

Dense Forests and

CLEARING



Forests of tall trees growing so close to one another that they exclude daylight, add greatly to the cost of new highways in northwestern California. The photographs on this page show the thickly wooded territory through which a new 9½-mi. gravel road recently was pushed at an expense to the state of $160,000 for clearing and grubbing alone. Scenic value of the forest is high, but so is the cost of clearing for roads that are built through it.

HEAVY TIMBER GROWTH *(above)* in northwestern corner of California entails clearing costs exceeding $18,000 a mile on portions of 9½-mi. highway between Last Chance and Flannigan's in Del Norte Co., built by Youdall Construction Co. and Charles Harlowe, Jr., under contract price of $678,000, in which clearing and grubbing items total $160,000. 25-FT. GRAVELED ROAD *(right)* through thick forest growth involves 675,000 cu.yd. of grading in 9½ mi. in addition to heavy expense for clearing and grubbing.

Cleave Direct Routes Through Mountain Ridges

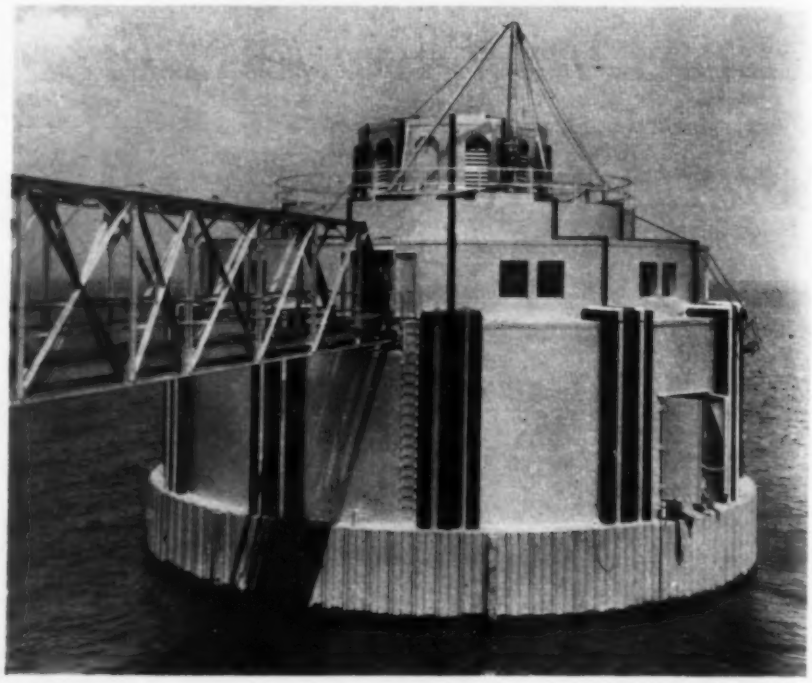
GRADING

Heavy grading completed last year in Piru canyon on the relocated Ridge Route between Bakersfield and Los Angeles approaches the record for this kind of work performed by the California Division of Highways. In the 2 mi. beyond the bridge which appears in one of the photographs on this page, the total material handled in building the road amounted to 1,202,000 cu. yd., or more than 600,000 cu.yd. per mile.

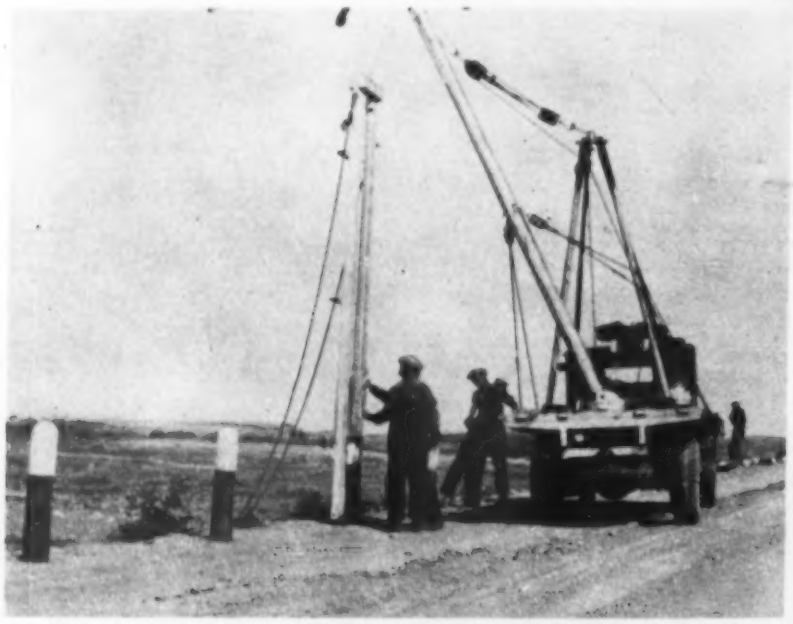
1,200,000 CU. YD. OF GRADING *(above)* precedes construction of 2 mi. of pavement beyond bridge in foreground on relocated Ridge Route between Los Angeles and Bakersfield, Calif. Cut immediately beyond bridge, 211 ft. deep and 420 ft. long, required excavation of 225,000 cu.yd. Distance on curve between bridges is 600 ft. ENTIRELY NEW LOCATION *(left)* through Piru gorge traverses 26 mi. of rugged territory which offers absolutely no tributary traffic except near ends of this section. THREE-LANE HIGHWAY *(in circle)* designed to lines and gradients meeting modern traffic requirements passes through succession of heavy cuts in Piru canyon.

Getting Down to
DETAILS

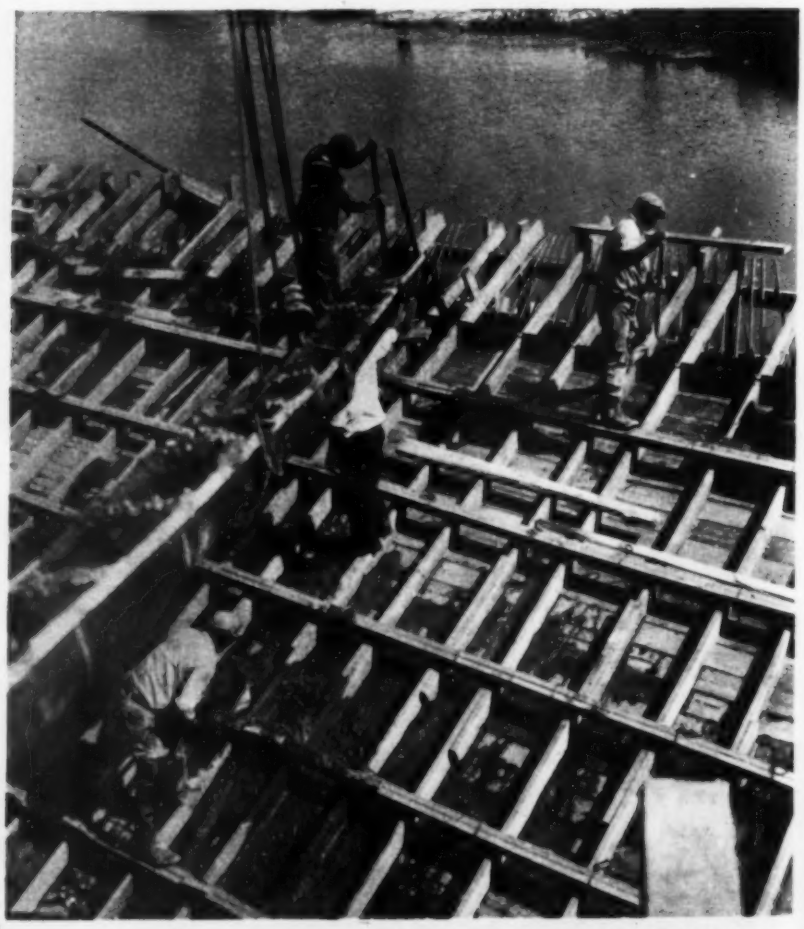
[Close-up Shots of Job Methods and Equipment]

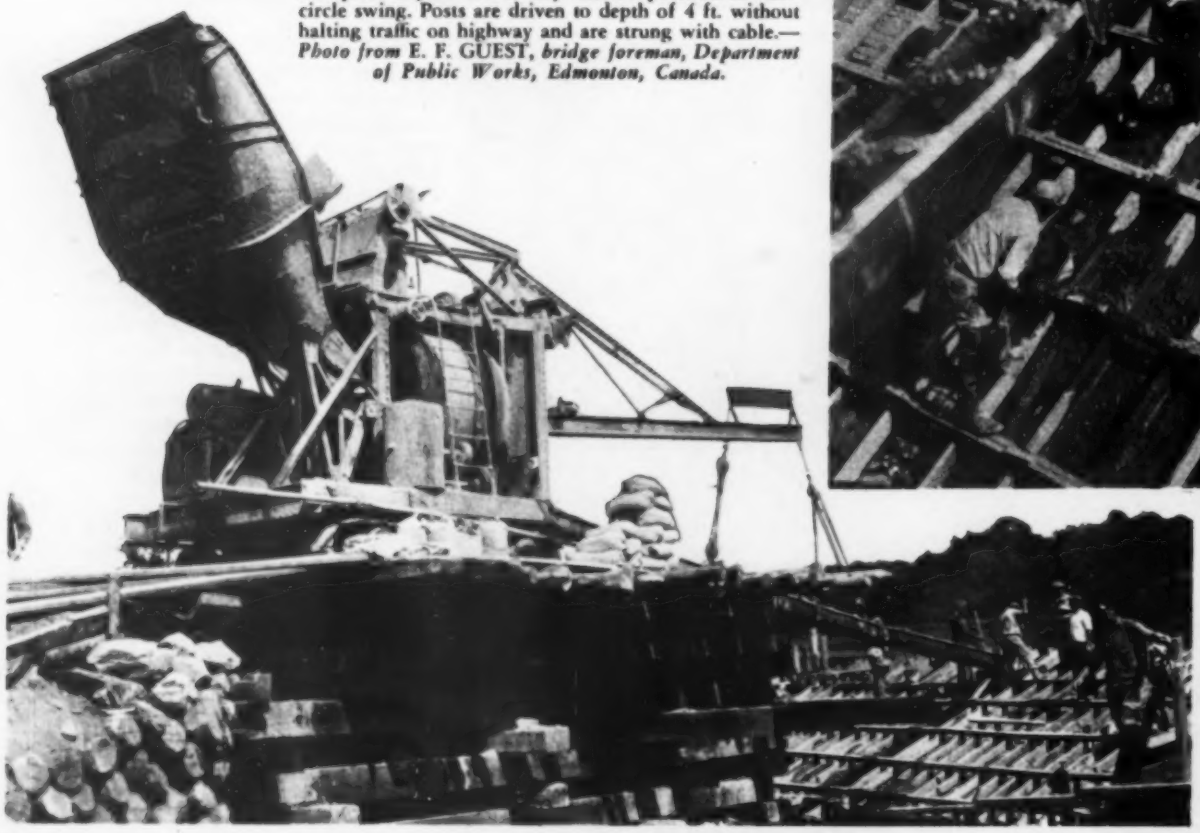


STEEL PLATE FACING, with ornamental buttresses of welded I-beams, plates and angles, constitutes radical departure in architectural treatment of superstructure for new William E. Dever crib for Chicago waterworks intake in Lake Michigan. Older intake cribs were granite-faced. Aluminum paint, with alternate black and silver stripes on buttresses, gives modernistic appearance to cylindrical top, 71 ft. 5½ in. in diameter, of structure supported by thick concrete cylinder within steel sheet piling. Intake delivers water through tunnel to Chicago Ave. pumping station.



HIGHWAY GUARD RAIL POSTS in Province of Alberta, Canada, are driven to place with this mobile rig, consisting of motor truck equipped with 900-lb. pile hammer in leads on boom mounted on turntable for quick adjustment to any desired position in half-circle swing. Posts are driven to depth of 4 ft. without halting traffic on highway and are strung with cable.— ***Photo from* E. F. GUEST, *bridge foreman, Department of Public Works, Edmonton, Canada.***

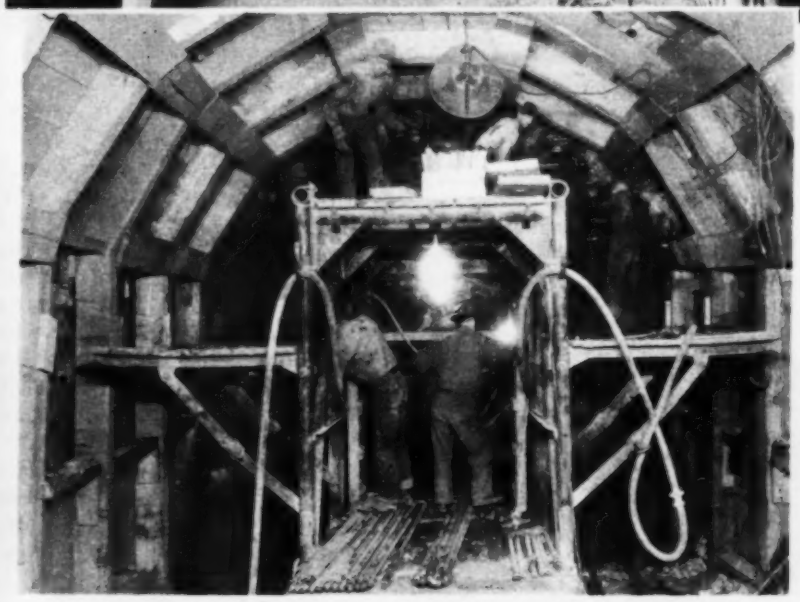




NEW ROLE FOR PAVING MIXER *(left)* **is provided by Sudbury River bridge project on Cambridge-Concord highway in Massachusetts, described in *Construction Methods* for January, p. 44. On boom of standard 27-E machine, elevated on timber cribbing at river's edge, B. Perini & Sons, Inc., contractors of Framingham, Mass., substitute inclined chute *(above)* for regular bucket in order to deliver concrete to wood forms for arch, which is to be finished with a facing of light gray granite. The mixer skip is charged by batch-trucks operating on a ramp. The boom of the mixer is utilized to support the chute by means of cables and pulleys as shown.**

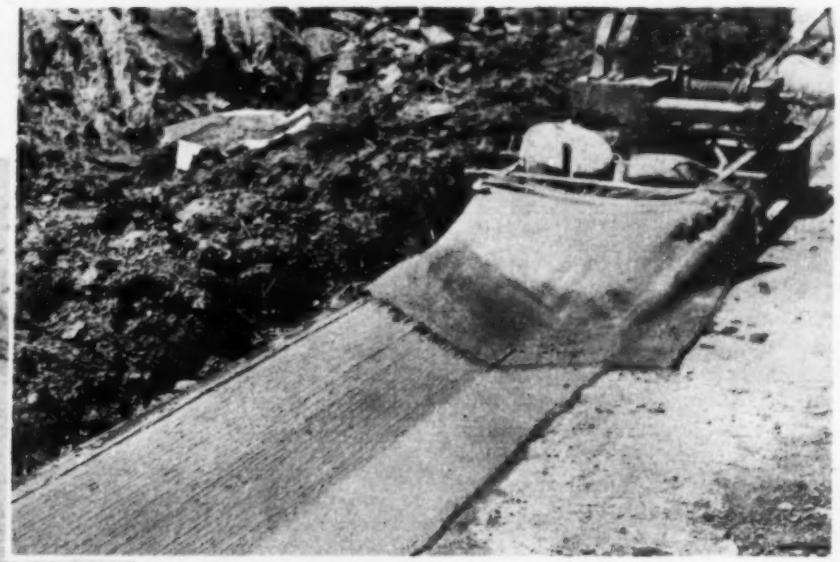
PORTABLE CEMENT PUMP unloads box cars shipped to Tennessee Valley Authority's Norris dam project on Clinch River. Mask protects operator from dust during handling of cement in bulk.

IMPROVISED VERTICAL DRAINS behind concrete retaining walls of New York Central Railroad's track elevation project in Syracuse, N. Y., are formed by perforating sides of old metal oil barrels (with ends removed) and filling them with coarse stone. Contractor, Walsh Construction Co.



TOGGLE-BRACED WINGS for drill carriages are being tried out in Colorado River aqueduct tunnels of Los Angeles Metropolitan Water District. Wings are working platforms on either side which fold down against frame of carriage before rig is moved. Wings are hinged to frame and supports consist of braces or brackets with central pin joint that will drop down, under influence of gravity, slightly below center line. Thus, support is locked in raised position until wing is lifted slightly. No bolts have to be loosened or removed, operation is speedy and device is safe because wings cannot fold down accidentally.

BLOWER ATTACHMENT to remove fine dust from road building aggregates is rigged on elevating bucket loading machine by Standard Asphalt Paving Co. of Spokane, Wash. The outfit was used on a bituminous contract on State Road No. 2 in Douglas, Grand and Lincoln counties.—*Photo from* L. V. MURROW, *director, Washington State Highway Department.*



FOR FINISHING GUTTERS *(at left and above)* of concrete pavement in Illinois, Beatty Construction Co., of Equality, Ill., developed this machine. It is hand-operated by cog gear and ¼-in. cable, 150 ft. long, running through pulley fastened to steel "mule" and back to revolving shaft on power unit, as shown in view at left. Appearance of finished gutter, in wake of burlap drag on rear end of machine, is indicated by photograph above.—*Photo from* C. M. HATHAWAY, *engineer of construction, Illinois Division of Highways.*

Progress Schedules Are Maintained in Building

ROCKEFELLER CENTER

ARCHITECT'S RENDERING of proposed design for Rockefeller Center *(left)*. Plans for buildings 4A, 4B and 6, in foreground, were modified before construction, as indicated by accompanying views of connected unit.

A SKILLED organization, designed and manned to meet the requirements of rapid construction on large building projects, today is completing its third contract in the northernmost block of Rockefeller Center, New York City. All three contracts, calling for structures of various types, have been executed in accordance with progress predicted by the builder, John Lowry, Inc., of New York City, before receiving the awards from the Todd, Robertson, Todd Engineering Corp. and Todd & Brown, Inc., managing agents for Rockefeller Center, Inc. During the execution of the first contract, which promised delivery of the world's largest theater and an interconnecting 31-story office building 11 months after placing the first foundation concrete, a general strike of the New York City building trades caused a total delay of 2½ months. In the last 50 per cent of the theater schedule and the last 40 per cent of the office building schedule, the contractor recovered this lost time and delivered the buildings ready for occupancy on the date promised. The recovery was made without resort to any high-pressure methods which might have affected adversely the cost or quality of the work.

Three contracts — Before awarding contracts for the three units of Rockefeller Center originally ready for construction in 1931 (the 70-story RCA building, the theater now called The Center Theater, and Unit 10, comprising the Radio City Music Hall and the 31-story RKO building), the managing agents invited bids from eleven construction firms of sufficient size and good reputation. All contracts were drawn on a basis of cost plus a fixed fee. In addition to figures on estimated unit costs and management fee, each bidder was asked to present other information — in particular a progress schedule and a guaranteed date of issuance of occupancy certificates. The last two items were given great weight in determining the awards. No provision was made in the contracts for an extension of time to take care of delays beyond the control of the contractor.

During part of the interim between its first and third contracts, John Lowry, Inc., was engaged in building two pedestrian tunnels under West 50th St. and a vehicular ramp from the north side of West 50th St. to the truck loading space under Rockefeller Plaza. These structures are indicated in the accompanying plot plan. Early in 1934, the Lowry organization was awarded a contract for Building 4A-4B-6 at the east end of the north block. These notes are limited to a consideration of the methods employed on this building and on Unit 10.

Theater and Office Unit—Rockefeller Center occupies almost the entire area of three large blocks covering more than 12 acres in midtown Manhattan, between 5th and 6th Aves. and 48th and 51st Sts. Unit 10 stands at the west end of the north block. The RKO office building, which rises to a height of 407 ft., has a frontage of 200 ft. 10 in. on 6th Ave. and 73 ft. on 50th and 51st Sts.

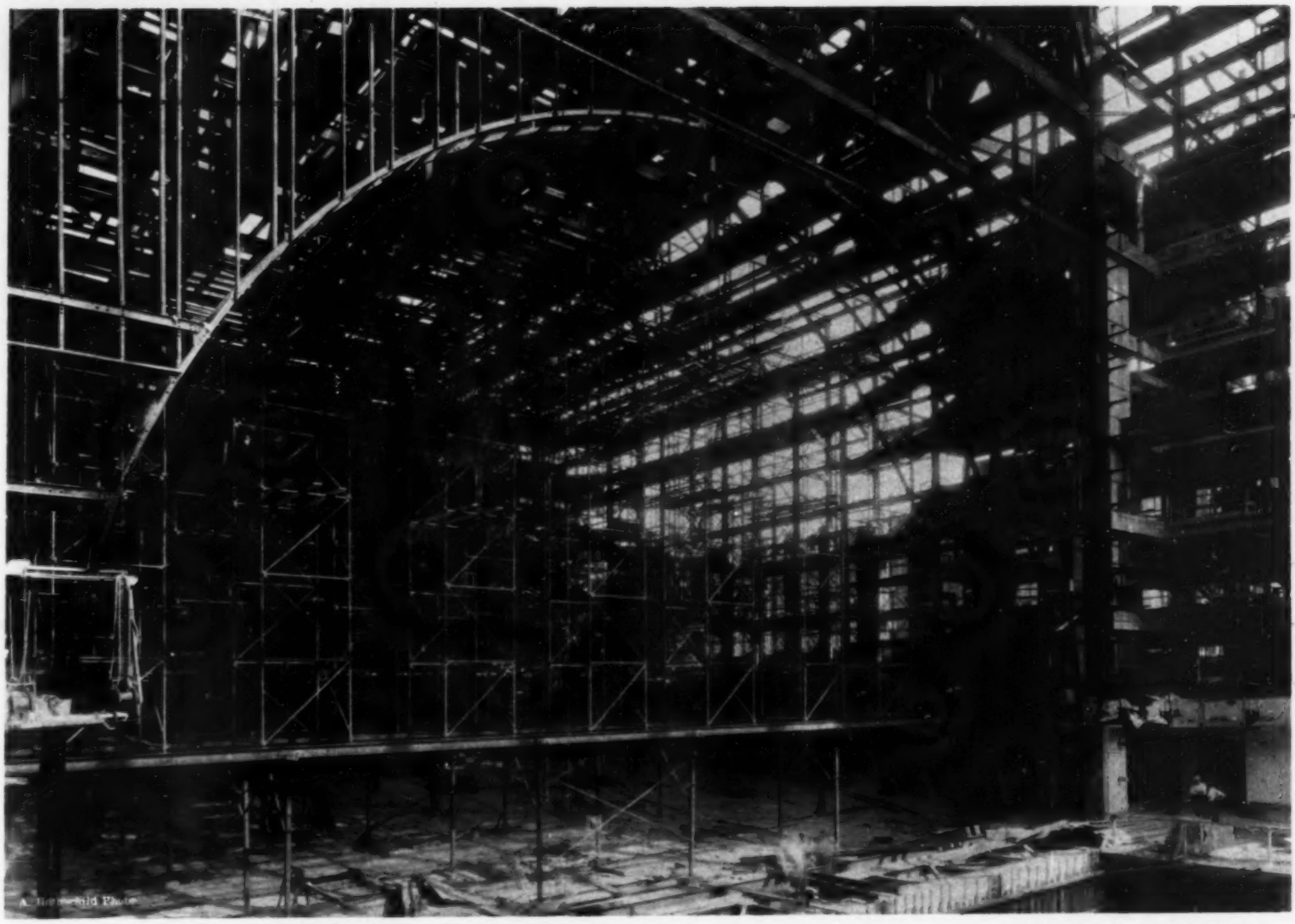
38-STORY OFFICE BUILDING now under construction occupies east end of north block in Rockefeller Center. In background are 31-story RKO building and Radio City Music Hall. Portion of vehicular ramp to underground delivery area appears against rear wall of theater.

Connected to the office building is the theater, covering an area 200 ft. 10 in. by 284¼ ft. and rising to a height of 121 ft., its roof on a level with the 9th floor of the RKO structure. The entrance to the theater is on 6th Ave., in the south end of the office building. A seating capacity of 6,200 in the theater is distributed about 3,500 on the main floor and the rest on three comparatively narrow balconies.

Structural framing of the two buildings is interconnected and interdependent. In addition to the entrance, the office building also contains the theater's grand foyer, 40 ft. wide and 80 ft. high, over the ceiling of which are trusses two stories (23 ft.) deep carrying 25 stories of the building above. Heavy proscenium and longitudinal trusses are required to bridge the long spans of the theater auditorium, which measures 175 ft. from the curtain line to the rear wall and which has a proscenium opening 110 ft. between columns. These trusses are designed also to support unusual roof loads imposed by a studio floor and by the garden landscaping which is a feature of all low flat roofs of Rockefeller Center.

Exterior walls of the RKO building and Radio City Music Hall, in common with all other buildings of Rockefeller Center, are faced with saw-cut Indiana limestone and cast aluminum spandrels. Permanent interior partitions, such as those around stairways and elevator shafts, are hollow terra cotta block or brick, and floor arches are 4-in. cinder concrete, which is typical construction for New York City buildings.

Present Contract—Building 4A-4B-6 is so designated because its design has developed from original plans calling

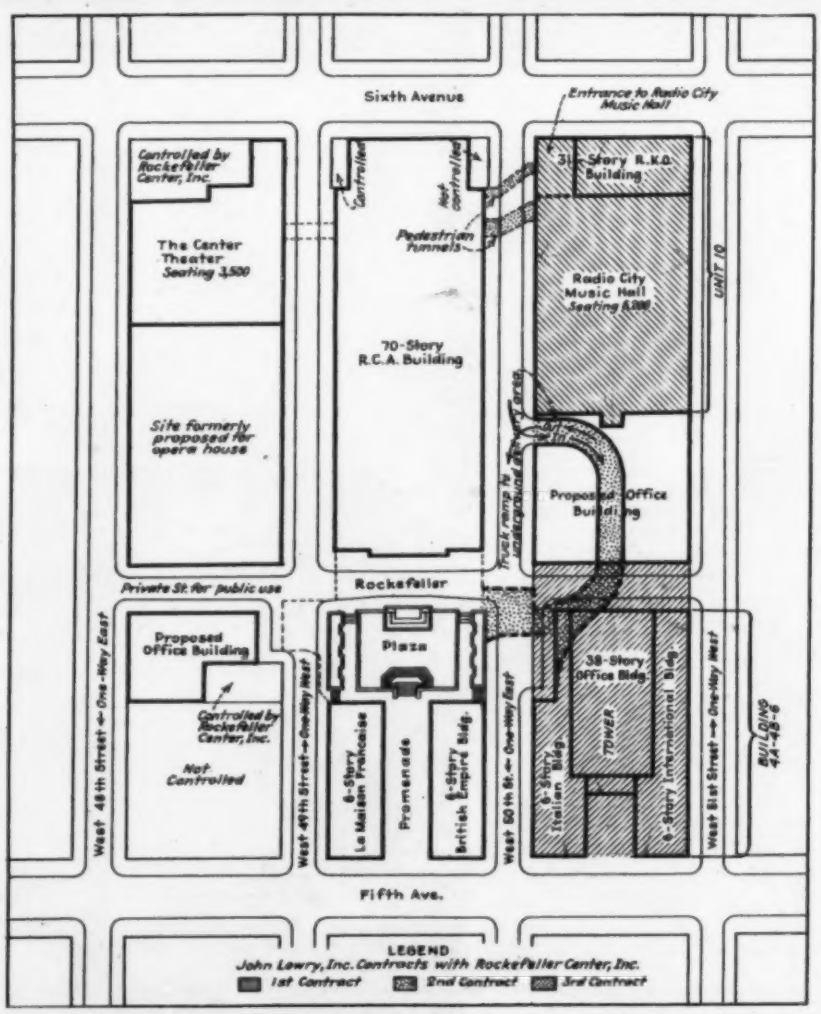


FOREST OF TUBULAR SCAFFOLDING erected clear of floor carries working platforms for erection of arched ceiling in Music Hall.

for three separated structures, two of which (4A and 4B) were to be 6-story buildings facing Fifth Ave., with a tower office building behind them having its longitudinal axis in a north-south direction. In the present construction, the three units are combined in a single building served by a central lobby, and the tower has been turned with its longer dimension running east and west. In plan, the building measures 200 ft. 9¼ in. on Fifth Ave. by 315 ft. on 50th and 51st Sts. A 30-ft. inset at the west end on the 50th St. side provides garden space opposite the plaza. Setbacks occur at the 2nd, 5th, 6th, 7th, 8th, 10th, 17th, 31st and 39th floor levels. The tower, about 120x400 ft. in plan, has 38 rentable floors above the street, with service and penthouse stories at the top, making 40 stories in all.

At the west end of the office building is an extension of the private street (Rockefeller Plaza) involving structural frame, walls, partitions and floors for a concourse level and sub-basement level below the street. A pedestrian tunnel from the shopping level of the sunken plaza crosses under 50th St. on top of the vehicular tunnel and connects with the concourse floor of the office building.

Progress Schedules — A serviceable progress chart was devised by the contractor to indicate in simple fashion

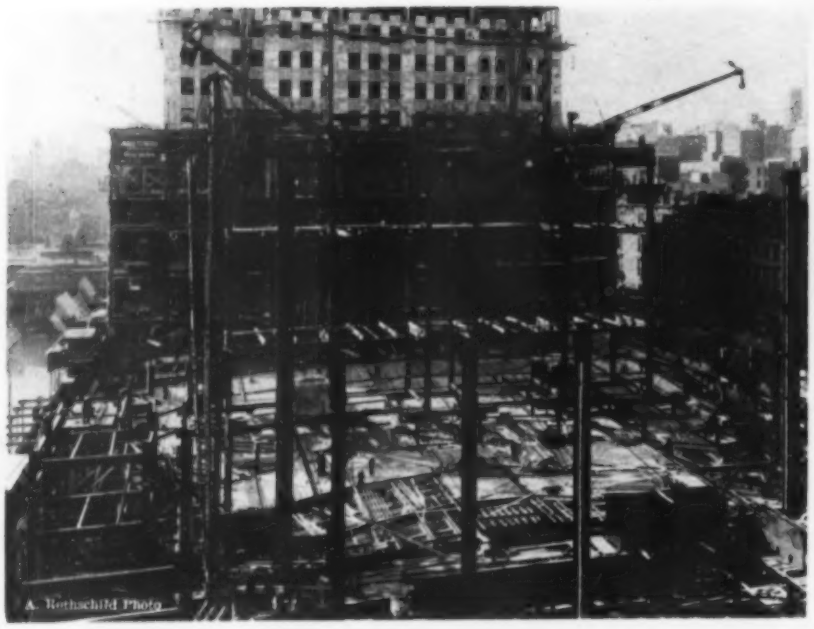


PLOT PLAN of Rockefeller Center. Buildings completed and under construction are indicated.

the relative positions of trades engaged on the building. Charts of this type were used both on Unit 10 and on the present contract. Each chart was built up on cross-section paper with the horizontal spaces representing time and the vertical spaces indicating floors of the building. By tracing the progress of the various trades on this chart with sloping parallel lines, the contractor easily determined the proper position of any trade on a given day and avoided any conflict of operations. The progress chart and organization chart for Building 4A-4B-6 will be reproduced with explanatory notes in the next issue of *Construction Methods*.

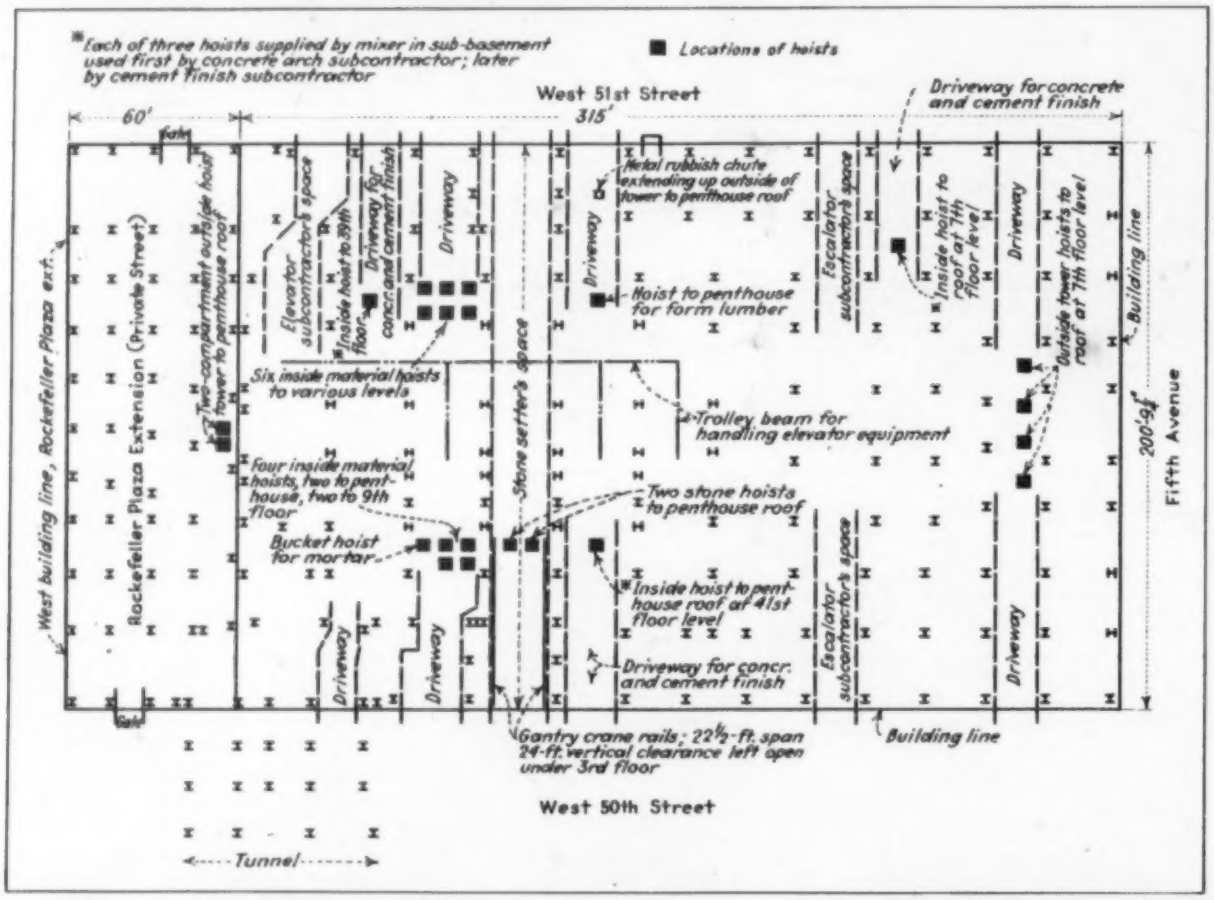
Job Organization—In the organization of contractor's personnel, each man is responsible to one superior, all division of responsibilities being avoided. The entire organization is under the direct control of the superintendent in general charge.

On both projects, it has been a matter of accepted procedure to have each subcontractor report by 9 o'clock every morning the number of foremen, mechanics and helpers working that day. This report enables the superintendent to check early each day any trade which is getting out of line with scheduled



A. Rothschild Photo

TRANSVERSE STEEL TOWER BENT *(left)* made up of members to be incorporated later in another structure serves as falsework to support six longitudinal trusses of theater during erection.


*Each of three hoists supplied by mixer in sub-basement used first by concrete arch subcontractor; later by cement finish subcontractor
Locations of hoists
West 51st Street
60'
315'
Gate
Driveway for concrete and cement finish
Metal rubbish chute extending up outside of tower to penthouse roof
Elevator subcontractor's space
Inside hoist to 35th floor
Driveway for concr. and cement finish
Driveway
Hoist to penthouse for form lumber
Escalator subcontractor's space
Inside hoist to roof at 7th floor level
Outside tower hoists to roof at 7th floor level
Building line
Rockefeller Plaza Extension (Private Street)
Six inside material hoists to various levels
Trolley beam for handling elevator equipment
Four inside material hoists, two to penthouse, two to 9th floor
Two stone hoists to penthouse roof
Bucket hoist for mortar
Stone setter's space
Inside hoist to penthouse roof at 41st floor level
Driveway for concr. and cement finish
Gantry crane rails; 22½-ft. span 24-ft. vertical clearance left open under 3rd floor
West 50th Street
Tunnel
200'-9"
Fifth Avenue

GROUND FLOOR PLAN of Building 4A-4B-6 shows location of hoists for construction of 38-story office structure and two connecting 6-story buildings facing Fifth Ave. Outside hoist tower recently erected in private street will be left in place to take care of tenant changes after inside hoists are removed.

progress. Meetings to iron out difficulties of a general nature are held every Tuesday at the job office and are attended by representatives of all subcontractors, of Todd & Brown, Inc. (supervisor of construction for the owner), and of the general contractor's main office.

A telephone switchboard in the job office is connected with numerous telephones distributed at convenient points on the project. Each member of the general contractor's organization has a distinctive ring which is used to summon him to the nearest telephone. By this system, the office can communicate promptly with any man on the job or with any part of the work.

Plant Layouts—A ground floor plan included with these notes shows the location of material hoists and truck driveways on the present project. Practically all hoist engines on the job, whether for elevators or derricks, are driven by electric power. The large number of material hoists are frequently pressed to the limit in moving materials to the upper floors as rapidly as required. Limestone facing for the tower is unloaded by gantry crane and delivered to upper floors by two inside hoists, as indicated on the layout. This method had previously served the same subcontractor, Thomas Rome, on the 70-story RCA building.

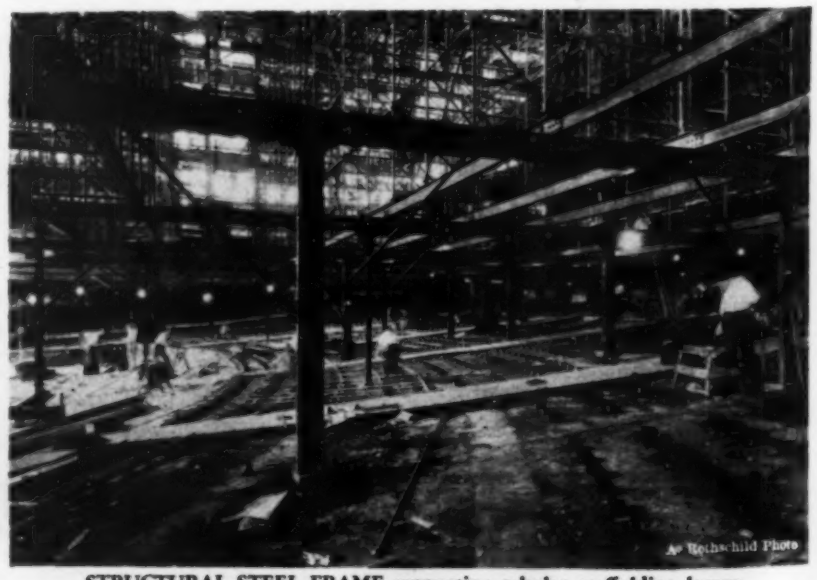
In Unit 10, a single set-up of mixing and hoisting equipment for cinder concrete served both buildings from a hoist tower rising through the grand foyer in the office building. Separate construction plant for each of the two structures handled all other materials. Stone was hoisted by derricks on the outside of the buildings. In addition to the cinder concrete hoist, the office building contained five material hoists. Six material hoists served the theater, two being placed inside the building and four outside along the east wall.

On both contracts lime-sand mortar from the plant of the Blue Diamond Service Corp. was delivered to the buildings, where portland cement was added and mixed. Mortar for office buildings is discharged by trucks on the first floor into a hopper in the basement. Cinder-concrete materials likewise are delivered by trucks on the first floor and passed by gravity through bins in the basement to the mixer. Mortar for the theater was discharged by the trucks into a box bin in an open area at the east end of the building.

Steel Erection — Conventional methods of steel erection with guy derricks raising steel from trucks in the street (using relays where needed) sufficed for the two office buildings. More interesting operations were involved in the theater. Steel in all the buildings has been erected by Post & McCord, Inc., of New York City. In 1931 this firm received a lump-sum contract for the erection of all steel in the first three Rockefeller Center units. Because of the all-inclusive character of this contract, the steel erector was able to use to advantage members from another unit in supporting the long roof trusses of the theater.

Falsework for the proscenium truss, which was 110 ft. long and 36 ft. deep and weighed 300 tons, consisted of a single timber tower, 9x9 ft. in plan and 112 ft. high, erected at the center of the span. Two guy derricks on the steel tier framing at the two sides of the stage placed the 60-ton bottom chord of the proscenium truss on this tower and erected the web members and top chord.

Six longitudinal trusses carry the auditorium roof. Four of these trusses are 175 ft. long and weigh about 260 tons each; the two other trusses have a span of 140 ft. and a weight of about 215 tons. Two of the 175-ft. trusses frame at one end into the proscenium truss. The others are supported at both ends by columns. To support these trusses during erection, the contractor installed



A. Rothschild Photo

STRUCTURAL STEEL FRAME supporting tubular scaffolding leaves floor clear for normal construction operation.

in the auditorium a transverse steel tower bent made up of structural members which were incorporated later in the RCA building, across 50th St. from Unit 10. It was necessary to provide a uniform level for this falsework bent. The contractor took care of this need by ordering that 22 of the columns supporting the dish-shaped auditorium floor be supplied in uniform length, which meant that a number of these columns projected 3 to 4 ft. above the concrete floor. Depressions were formed around the columns in the concrete slab to permit flame-cutting of the projecting steel after the falsework had been removed.

The four 175-ft. trusses rested directly on the steel falsework bent. Girders spanning between the steel falsework and the tier framing along the outside walls of the theater supported the two 140-ft. trusses. The two derricks on the theater frame at the two sides of the stage and two others resting on a setback of the office building were able to place nearly all the steel in the trusses. To erect members at the centers of the trusses which could not be reached by these rigs, the contractor set two 20-ton derricks on the steel falsework bent.

Floor Arches and Finish—At Unit 10, cinder concrete for the more than 400,000 sq.ft. of 4-in. floor arches and for the fireproofing of the structural members was produced by a 1-yd. mixer situated in the basement under the grand foyer. A 1:2:5 mix of cement, sand and hard coal cinders was specified for the floor arches and fireproofing. For the 1,122,000 sq.ft. of cinder concrete arches involved in Building 4A-4B-6, the Washington Concrete Corp., subcontractor, used two 1-yd. and one ¾-yd. mixers. These mixers and adjacent hoists later served Brennan & Sloan, Inc., subcontractor for the cement finish. This firm placed a 1-in. finish of dry concrete on top of a 3-in. tamped cinder-concrete fill and produced a dense, smooth, quick-hardening surface by hand rolling, power floating, and troweling.

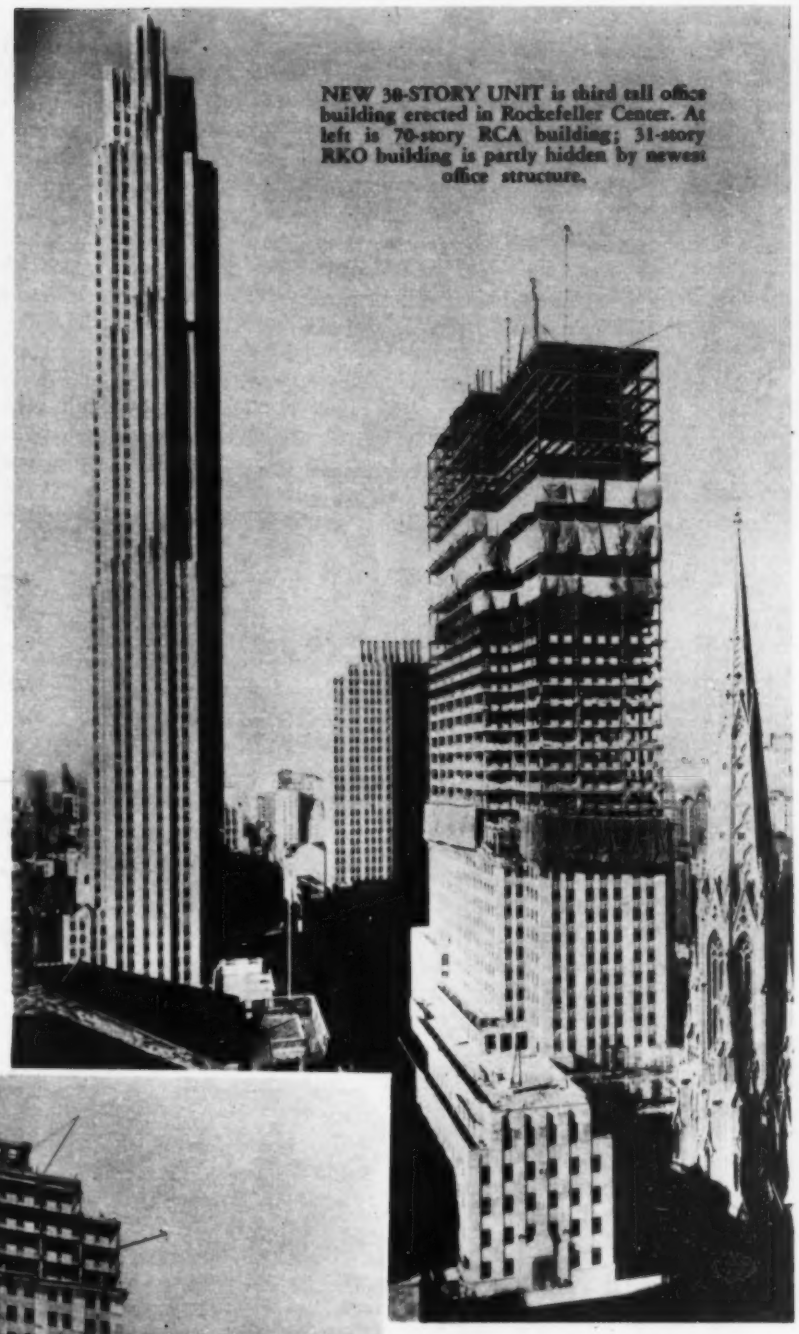
Wall Construction—Saw-cut Indiana limestone 4 in. thick (with an 8-in. bond stone in each pier at every story) was selected for exterior walls of Rockefeller Center because of its comparative economy, availability in large quantities, pleasing texture, and resistance to disintegration. The building code requires 8 in. of solid brick backing behind the thin wall facing. In all, Unit No. 10 required 70,400 cu.ft. of limestone and over 5,000,000 common brick. In addition, the two buildings of the unit involved almost 700,000 pressed brick, 350,000 glazed brick (principally for the walls of the stage), and 750,000 sq.ft. of hollow terra cotta block. Building 4A-4B-6 requires about 35,000 cu.ft. of limestone and about 5,000,000 common brick, in addition to about 300,000 face brick for lining the fire tower. On this project, Simplon metal furring to which were attached vertical channels to support wire lath replaced the 3-in. terra cotta furring used on the former contract.

Aluminum Spandrels — Thin spandrels were required in the design of the Rockefeller Center buildings to permit recessing of radiators and Maxim Campbell silencer-ventilators in the walls under the windows. The designers selected cast aluminum for the spandrels because of its lightness, price, and color, which harmonized with the limestone facing. Unit No. 10 called for total of 1,714 cast-aluminum spandrels and Building 4A-4B-6 for 2,281. The spandrels were attached to the upper and lower flanges of the spandrel beams by bolted brackets and clips. Means of vertical adjustment was provided by slotted holes in the lugs of the spandrels to which the brackets were bolted.

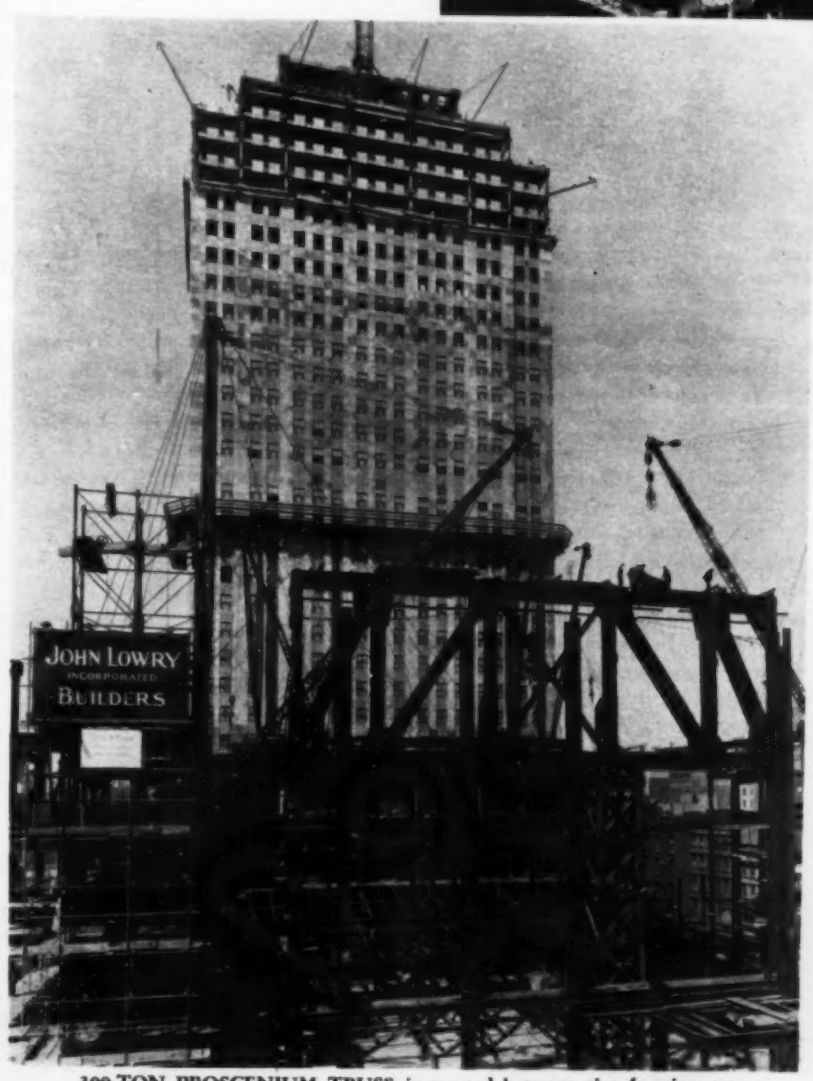
Stage Construction — A number of innovations were incorporated in the theater stage, which measures 144 ft. by 60 ft. in plan and has a clear height of 105 ft. from the stage level to the grid. A rectangular center elevator platform, 70 ft. long and 45 ft. wide, is divided lengthwise into three sections, each of which is mounted on two hydraulic plungers. By means of these plungers the sections can be raised or lowered independently or in unison, making possible terrace effects on the stage. Each of the vertical plungers operates in a well, 3 ft. in diameter and 54 ft. deep, excavated in solid rock under the sub-basement. The stage elevator platform also includes a turntable. When the three sections are the same elevation, they automatically lock, and the turntable then can be revolved in either direction.

Similar plunger elevator construction was employed in the design of the orchestra pit, which also is carried on two hydraulic pistons. As a further innovation, the orchestra is seated on a rolling platform, called the "band wagon," which carries storage batteries for its own propulsion. The orchestra platform can be lowered by the hydraulic machinery to the level of the sub-basement and can there move to any section of the lowered stage elevator. A rigid movable asbestos fire wall between the orchestra pit and the stage at the sub-basement level can be raised to permit this movement. Peter Clark, Inc., of New York City, designed and built the stage equipment.

Because of the great height of the stage, the inclosing walls, which are of solid brick construction faced on the



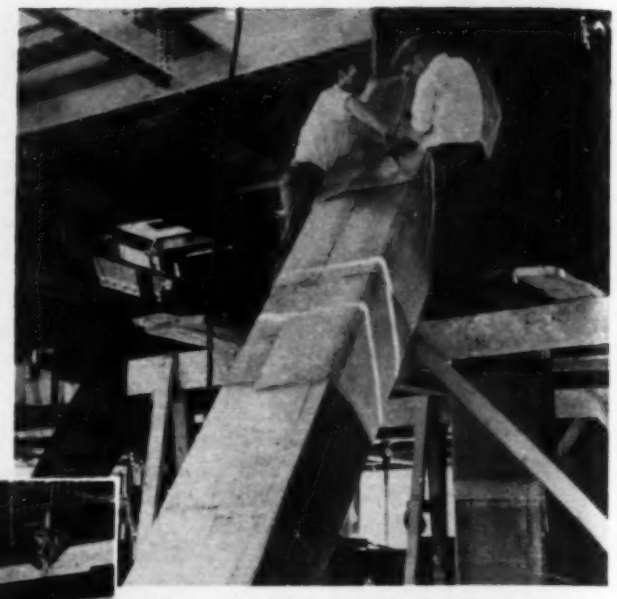
NEW 38-STORY UNIT is third tall office building erected in Rockefeller Center. At left is 70-story RCA building; 31-story RKO building is partly hidden by newest office structure.



300-TON PROSCENIUM TRUSS is erected between tier framing on two sides of stage with aid of single timber falsework tower 112 ft. high.

CAST ALUMINUM SPANDRELS are attached to beams by bolted brackets and clips. Spandrel lugs have slotted bolt holes to permit vertical adjustment.

WORKING PLATFORMS at various levels on tubular scaffolding in theater facilitate construction of ceiling arches.



METAL FABRIC is wrapped around built-up roof truss members in Music Hall as base for 2-in. cinder-concrete fireproofing.

inside with glazed brick, were erected with hanging scaffolds. The back wall of the stage, which also is the end wall of the theater, is faced on the outside with pressed brick. A proposed building eventually will hide this wall.

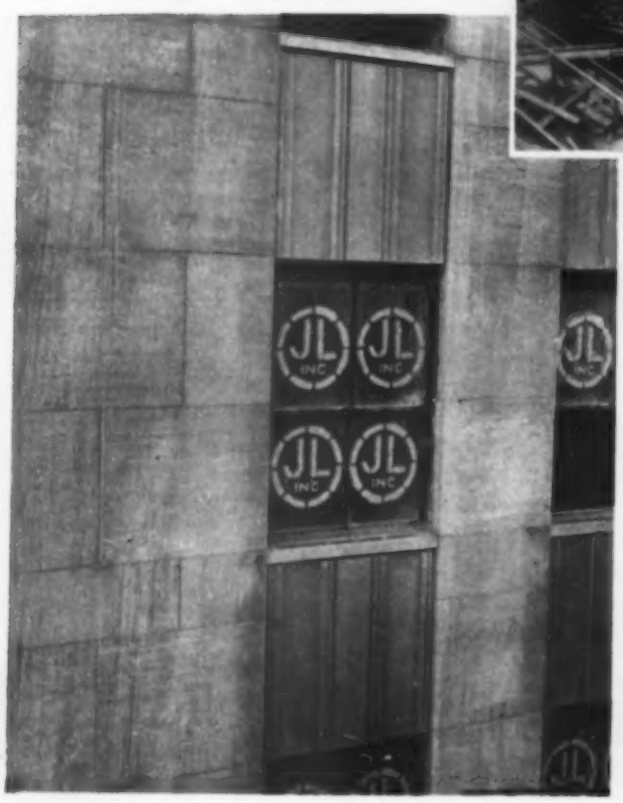
Theater Ceiling—For acoustical reasons, the ceiling of the auditorium was designed as a series of elliptic arches parallel with the curtain line and 17 to 25 ft. wide, with 2-ft. steps between adjacent arches forming coves in which lights are concealed. The ceiling is suspended from the structural frame, and the arches themselves are of acoustical plaster, with hard plaster ridges about 6 ft. apart. A veritable forest of tubular steel falsework was erected under subcontract by the Archer Iron Works to permit hanging of the light steel arch frames and installation of metal lath and plaster for this ceiling.

To provide a level base for the tubular scaffolding and to eliminate the necessity of supporting the scaffolding on the theater floor, where it would have interfered with other construction operations, the subcontractor designed a structural steel frame erected directly over the columns carrying the floor. Steel for this scaffolding sub-structure, amounting to about 50 tons, was fabricated at the Jersey City plant of Joseph T. Ryerson & Sons, Inc. On the beams of the structural steel frame, the subcontractor erected tubular steel towers in transverse rows about 17 ft. on centers. The towers were stiffened and interconnected at the top to form a scaffolding unit by horizontal girts and diagonal braces in two directions. All connections were made with bolted adjustable swivel clamps which could be used to connect diagonal members at any angle.

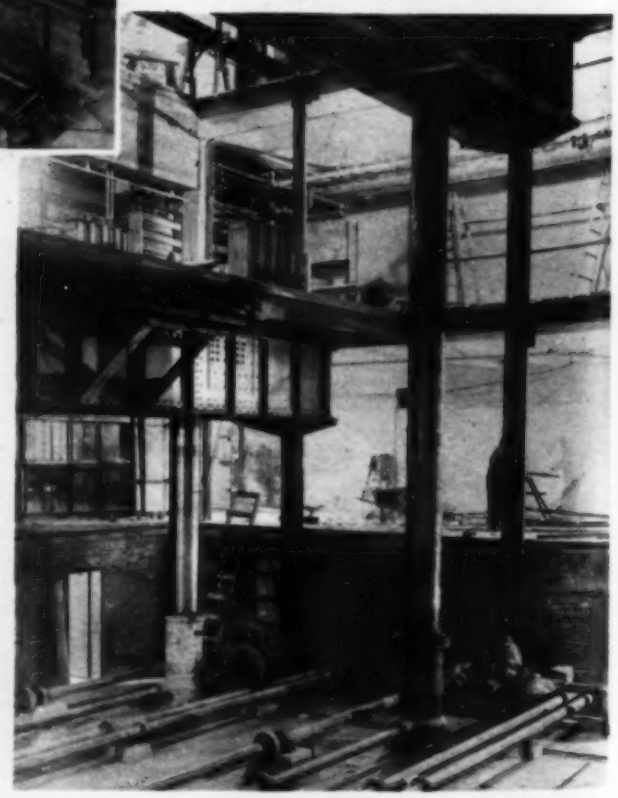
Tubular members and clamps required for the scaffolding, which extended to a height of about 80 ft. above the theater floor, aggregated about 250 tons in weight. Sections of the tower legs were of uniform length, 6½ ft., and the scaffolding along the sides of the auditorium was terminated at various levels to permit decks to be installed in conformity with the shape of the ceiling arches. At no point was the final plastered surface more than 12 ft. above the working deck.

A notable feature of the scaffolding was the employment of trusses made up of standard tubular members. In front of the proscenium arch, the subcontractor projected the scaffolding across a span of 22 ft. from the towers to the arch by trusses supported at one end by the towers and at the other end by wire-rope hangers suspended from the structural roof frame. The trusses were braced transversely. At the rear of the theater, the scaffolding designer span-

SAW-CUT LIMESTONE *(below)* and aluminum spandrels form exterior facing of all buildings. Double-hung steel windows are standard in office structures.



HYDRAULIC PLUNGERS *(below)* raise and lower three sections of stage elevator platform. Orchestra pit also is carried on two hydraulic pistons.



ned the distance between the towers and the rear wall (above the balconies) with trusses 32 ft. long extending from the towers to a tubular supporting frame resting on the third balcony.

As a precautionary measure, wire-rope cables suspended from the roof frame were attached to the trusses at the centers of the spans. These cables remained slack throughout the duration of the work, as was to be expected from the fact that the trusses had been designed for a live load of 50 lb. per square foot with a safety factor of 4 to 1. It was necessary to remove the cables to close the holes in the plaster arches before the scaffolding was dismantled.

Scaffold decking required 10,000 2x9-in. by 13-ft. planks which had been chemically treated to make them fire-resistant by the Protexol Corp., of Kenilworth, N. J. A large central platform, about 90x110 ft. in area, was used in laying out and connecting the light structural framing of the ceiling arches. After this framing had been erected, plasterers erected on the tubular scaffolding an additional timber scaffold which paralleled the contours of the ceiling arches. Following the completion of the ceiling, the Archer Iron Works dismantled the scaffolding in seven consecutive 8-hr. shifts on one week-end, from 4 p.m. Friday to 12 midnight Sunday.

Safety Measures — Photographs reproduced with these notes show the general contractor's method of protection around inside hoistways. Hoist gates are of two types. One type consists of two hinged rails, connected by a steel swivel strap and operated as shown by one of the photographs. George M. Croll, superintendent, had developed and used this type of gate on previous jobs. A smaller number of the hoistway gates are of the counterweighted type. Although more expensive to install and more likely to get out of order, this type of gate has the one advantage that it provides a toeboard. Diamond-mesh panels 8 ft. high stapled to wood posts complete the protection of interior hoistways.

LIME-SAND MORTAR from commercial plant is delivered in trough-shaped 6-yd. trucks equipped with spiral screw for unloading.

COUNTERWEIGHTED HOIST GATE provides toeboard to prevent objects from falling into shaft.

SWIVEL-TYPE GATE is easily operated and simple to install. Wire panels complete hoist protection.

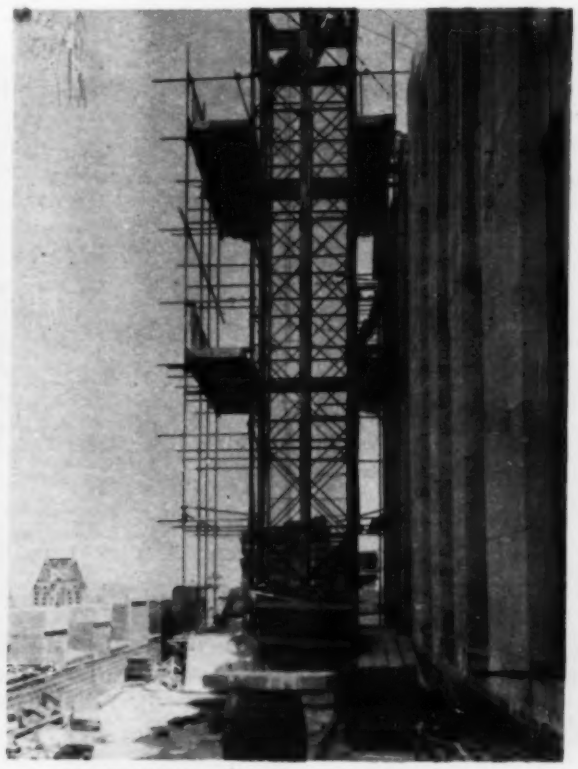
Temporary handrails are erected on all stairs. Where no other support is available, these rails are attached to the stairs by bolted clamps. Temporary doors at the elevator shafts are covered to prevent drafts in cold weather. In those shafts which are operating, these doors can be opened only from the inside. A catch scaffold was erected under the bricklayers' scaffold on the real wall of the stage, rising to an unbroken height of over 100 ft.

Sidewalk bridges, truck driveways and tubular towers are installed and maintained by the Chesbro-Whitman Co., of Long Island City. At each unloading level, tower hoists are provided with a platform on three sides of the tower. This arrangement speeds up the work of moving wheelbarrows on and off the hoist platform.

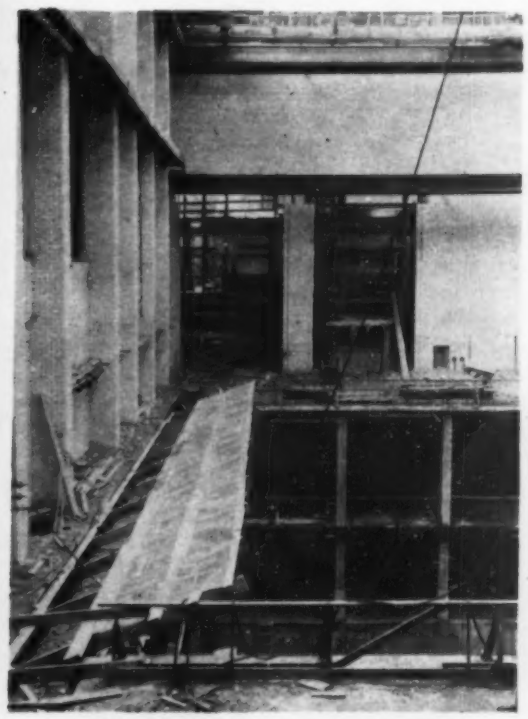
Administration—Rockefeller Center is being constructed for Rockefeller Center, Inc., under the broad supervision of the Todd, Robertson, Todd Engineering Corp., which handles the major problems of finance and renting and decides questions of policy. Todd & Brown, Inc., has specific charge of construction and represents the management in relations with the general contractors and architects. Ernest L. Smith is project manager for Todd & Brown, Inc.

George M. Croll, superintendent, has directed construction of all three contracts for John Lowry, Inc. A group of associated architects has designed all the structures in Rockefeller Center. This group is made up of Reinhard & Hofmeister; Corbett, Harrison & MacMurray, and Hood & Fouilhoux. Clyde R. Place is mechanical engineer and H. G. Balcom is structural engineer.

TEMPORARY HANDRAIL is attached to steel stairs by bolted clamps.



PLATFORMS on three sides of two-compartment tower facilitate handling of wheelbarrows.



CATCH SCAFFOLD is erected under bricklayers' scaffold on high rear wall of stage.

BAKING HOT CAKES at rate of 300 per minute (*left*). Pouring and turning are done from each end toward the center. Eight cooks have to step lively in this operation.

Hot Cakes for Breakfast

At Rate of 300 Per Minute

HOT CAKES for 2,000 hungry men would be too big an order for the ordinary commissary kitchen, but in the commissary department at Boulder City a system has been developed which not only could but did meet this order seven days a week for many months. How they did it is just part of the interesting story of commissary operations for Boulder Dam workmen, where 2,300 men were fed three meals a day at the height of operations. The number is now decreasing as the work nears its close.

Efficient Layout—The mess hall is shaped, in plan, like a narrow letter H with the kitchen centrally located in the crossbar. The two dining rooms seat 1,400 men on chairs (no benches are used) and there is ample room at spacious tables which must of necessity be large because of the variety of the foods that are set upon them. For example, a typical breakfast includes hot biscuits, toast, potatoes, bacon, sausage, boiled eggs, coffee, milk, dry cereals, hot cereal, grape fruit, prunes, hot cakes and maple syrup. Nor is there a limit on quantity; alert waiters move swiftly and constantly along the tables to which they are assigned and any dish that is emptied is replaced or refilled at once.

Only by checking over the quantities of supplies used is it possible to realize what enormous quantities of foods are consumed. Freight shipments average 30 tons per week of fresh fruits and vegetables; daily requirements include 8,000 eggs, 30 boxes of apples and 2,000 quarts of milk—an average of one quart per man in addition to tea and coffee and, in summer, lemonade. Five times a week the menu includes ice cream, placed on each table in heaped up bowls from which the men help themselves. The ice cream comes from a machine which turns out a high quality product at the rate of a batch every 3 min.—about 150 gal. per hour. From the freezing machine the product is stored at 10 deg. below zero until it is served. About 300 gal. of ice cream is served at one meal.

Fresh Foods Only—Very few ready cooked canned foods are used as all vegetables and fruits are brought in fresh. A few varieties, such as strawberries, are shipped in "fresh frozen" cans because in that form they reach this desert destination in the best shape. Only two vegetables are not served fresh—peas and spinach, the former because shelling machines are not satisfactory and the latter because of the extremely large size containers that would be required to start the cooking.

Hot Cakes in Quantity—Cooking is done chiefly with electric ranges, modern in every respect and located to reduce to a minimum the time and distance involved in getting food from stove to table. The hot cake operation is typical: Eight cooks bake hot cakes, four working on each side of a long double range. Each cook begins pouring batter at the outer end of a range and works toward the middle. By the time he reaches the middle the cakes that were poured first are ready for turning and he quickly returns to the starting point for a second trip along the line, this time deftly turning over each nicely browned cake. Immediately after turning he makes a third trip, scooping up four to six cakes at a time and thus clearing the griddle for the next pouring.

Temperature of the hot griddles and speed of the cooks is such that something over 600 cakes are turned out in about 2 min. This operation is timed to conform exactly with the entire breakfast schedule and at the instant the cakes are ready a line of white aproned waiters appears to rush the steaming hot cakes into the dining room where they reach the tables only a few seconds after leaving the griddle and at a time when the men are near the end of the first course of breakfast.

Organization—The head chef is responsible for coordination of the several operations to agree with a predetermined schedule. In fact, he operates the controls of the whistles which announce to the camp the official hour at each meal time. When the whistle blows the mess hall doors open and waiting lines of men flow quickly into the dining rooms. A certain number of minutes, exactly timed, before this whistle blows, the hot foods are placed on the table; the waiters making the last placement barely have time to get out of the aisles before the hungry horde rushes in. As soon as the men are seated, waiters again move up and down the aisles, each with a watchful eye for foods that need replacement. The waiters and, in fact, the entire kitchen crew are selected with a view to speed. There are 85 or 90 of them; practically all young men trained to move swiftly as they play their parts in the teamwork of speedy service. They are given a thorough physical examination before being accepted for employment and are checked up by the company doctor every two weeks thereafter.

Self-Help Lunches—A novel feature of this commissary is the lunch cafeteria. Although the commissary puts up standard lunches which may be taken by the workmen with much less time and effort on their part, most men prefer to take advantage of the opportunity to pack their own lunches. An array of foods suitable for cold lunches is placed on long counters and any workman, in place of the ready packed lunch, may take an empty lunch box and fill it with selections of his own choice. A large sign invites the men to "take all you want but don't waste." Although a few abuse the privilege which this freedom of choice gives, and take excessive quantities—perhaps for the purpose of supplying someone on the outside—the average worker prefers to pack his own for reasons of selection rather than quantity and the checker at the exit has little to do other than to record the tag number of each workman as he passes.

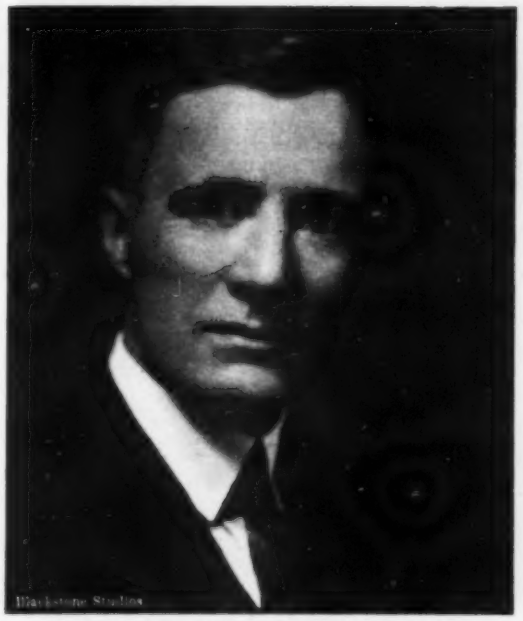
Dish Washing—An item of special interest in the kitchen equipment is the dish washing machinery. After food remnants are removed at a scraping bench, dishes brought from the dining rooms after meals are sorted by size, and plates, saucers, cups, etc. go to different machines. In copper-lined compartments the dishes move on endless conveyor racks through successive baths of steam, hot suds and rinsing sprays, which thoroughly sterilize and cleanse them, finally delivering them so hot that they dry without wiping and with brilliant surfaces. Like the serving of hot food, this process of cleaning up is a teamwork operation; the young men tackle it like a football squad working against time. In less than half an hour after 2,000 men have eaten, dishes are cleared away, remnants cleaned up and the whole plant is in sanitary, spick-and-span shape ready for preparation of the next meal. In fact, it has to be so because with hot meals to be served for three shifts (in addition to lunches) there is very little time, day or night, in which the kitchen is not busy in serving or in preparatory operations of some form.

The commissary for Six Companies Inc. is handled by the Anderson Bros. Supply Co. of Los Angeles and Boulder City.

ONE OF TWO duplicate dining rooms (*below*) before food service begins. Chairs are used instead of benches.

Present and Accounted For —

A Page of Personalities



NEW YORK CONTRACTORS' LEADER. James L. Carey is the newly elected president of the General Contractor's Association of New York City, succeeding Ray N. Spooner. Mr. Carey is vice-president of the Necaro Co., Inc., general contractor, of Brooklyn, N. Y., specializing in heavy construction.

HEADS CONSTRUCTION LEAGUE. Col. John P. Hogan, consulting engineer and member of the firm of Parsons, Klapp, Brinckerhoff & Douglas, New York City, is the newly elected general chairman of the Construction League of the United States, consisting of 22 member organizations representing all elements of the construction industry.

INDIANA CONSTRUCTION LEADER. John J. Quinn, owner of the Quinn Construction Co., of Bedford, Ind., was elected president of Indiana Highway Constructors, Inc., local branch of the Associated General Contractors of America, at its recent annual convention.

Four New State Highway Engineers

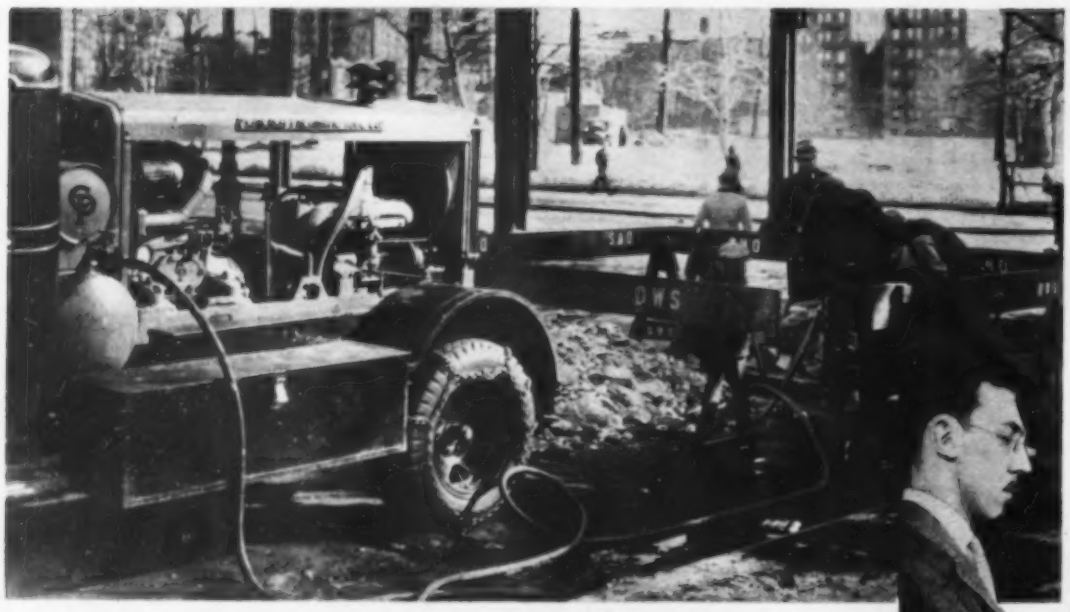
NORTH CAROLINA. W. Vance Baise, after 15 years of service in the state highway department, has been named state highway engineer to succeed John D. Waldrop.

OHIO. John Jaster, Jr., former division engineer and member of contracting firm of Uhl-Jaster Co., Cleveland, succeeds O. W. Merrell as director of highways for the state of Ohio.

LOUISIANA. Harry B. Henderlite, who has served several terms as chief engineer of the Louisiana Highway Commission, has been reappointed to that position to succeed W. H. Norckauer.

NEW MEXICO. Grover F. Conroy, connected for 20 years with the New Mexico Highway Department as locating engineer, project engineer and district engineer, has been promoted to be state highway engineer, succeeding Glenn D. Macy.

NEW EQUIPMENT ON THE JOB



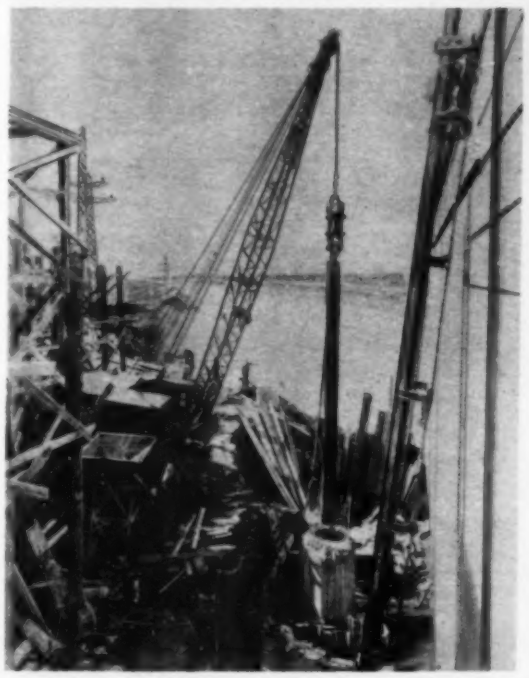
ECONOMY OF OPERATION is chief feature of this two-stage, air-cooled compressor which, at 100-lb. pressure, requires 15 per cent less power per foot of air delivered than single-stage unit. Other features:—Simplicity—no more parts than single-stage type; 6-cylinder engine which provides smoothness of operation and easy starting; low maintenance cost—full floating piston pins (no seizures or cylinder scoring); force feed lubrication; free-air unloading system; Simplate valves; self-adjusting clutch; cast steel deck. Four models, capacities ranging from 105 to 315 cu.ft. free air per minute and with bores and strokes respectively of 4x4¼, 4½x4¾, 4⅞x5¼, and 5¾x6 in.—Chicago Pneumatic Tool Co., 6 E. 44th St., New York City.

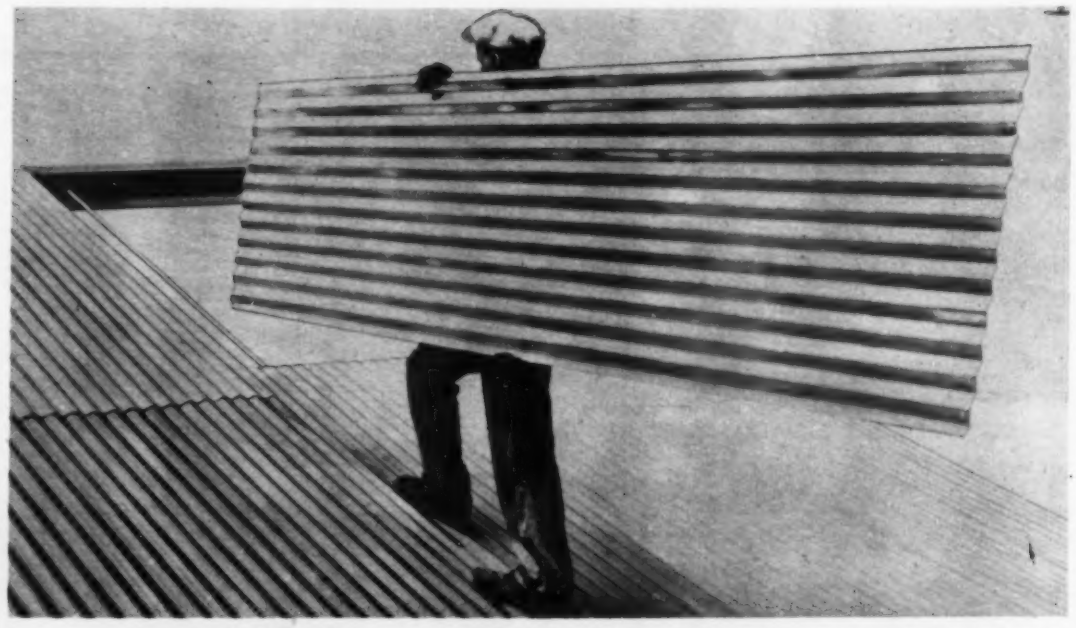
BLUE PRINT MACHINE *(below)* utilizes new Angstrom blueprint lamp instead of conventional arc and mercury-vapor types. This lamp operates on regular 110-115 d.c. or a.c. current, without need of transformer choke coils, and produces stronger light in blue end of spectrum. Blueprint machine is portable table type and prints one 18x24-in., two 12x18-in. or four 9x12-in. prints at one time. To make print, tracing or paper is placed on plate glass top, pressure pad is lowered and cover is closed. After proper exposure prints are washed and dried on special drying board furnished with machine. Additional features: one print can be made as cheaply as a dozen; entails no fire or accident hazard; no special electric equipment required. Operating cost, 2¾c. for 18x24-in. print.—Milligan & Wright Co., 4731 Prospect Ave., Cleveland, Ohio.

PORTABLE GASOLINE HAMMER, for use in all demolition activities, is air-cooled, 2-cycle, single-cylinder hammer striking from 1,200 to 1,500 blows per minute and accommodating any standard 1⅛-in. hex shank tool. Advantages: One-man operation; portable—heaviest unit weighs 89 lb.; not affected by weather; operating cost approximately 20c. per hour; lubricated by adding oil to gasoline; simple construction—no crank shaft, connecting rod, flywheel or bearings; takes but few minutes to dismantle or assemble; uses low-test gasoline.—Barco Manufacturing Co., 1801—1815 Winnemac Ave., Chicago, Ill.

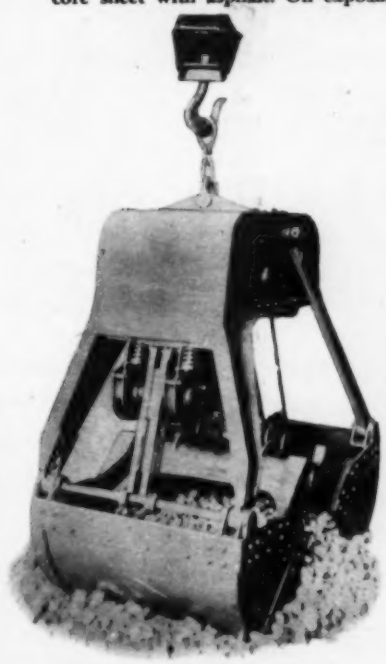
SELF-PROPELLED BLACK-TOP PAVER *(below)* lays without use of road forms, bituminous pavements having excellent riding qualities. Telescopic (adjustable for 9- to 15-ft. widths), machine handles 400 to 1,000 tons of material per day. Material is received in hopper and is pushed forward by paver at speed necessary to supply spreader screw distributing material. Equipped with straight-edge runners (really movable forms) 18 ft. long to bridge depressions in subgrade. Runners may be lifted in 2 sec. for maneuvering. Standard, oscillating-type screed is mounted on these runners and can be set for any specified crown and thickness of spread, from 1 to 6 in. Power-driven screw and heater help break up lumps in material. Unit automotive construction throughout, with 32-hp. engine and variable speeds forward of 12 to 25 ft. per minute; up to 120 ft. per minute in reverse.—The Jaeger Machine Co., Columbus, Ohio.

FOR PULLING new and larger types and sections of piling and sheeting this late model larger and more powerful double-acting pile extractor *(below)* has been designed. Photograph above shows extractor withdrawing steel sheeting which had been driven through 40 ft. of hard clay into 5-ft. bottom layer of wet sand containing numerous boulders and as hard as possible against solid rock in order to obtain water seal. Bottom ends of piles were torn, bent and crimped in many places. With power from crawler crane piles were easily extracted. Weight of extractor, 4,400 lb. Bore, 9 in.; stroke, 3 in. Maximum crane pull, 100 tons.—McKiernan-Terry Corporation, 15 Park Row, New York City.





COPPER COVERED Robinson protected metal is offered builders who require roofing and siding material possessing distinctive eye appeal, for use in construction of industrial, public and commercial buildings, bridges, canopies for railroad stations and other like structures. Exterior surface consists of Anaconda "electro-sheet" copper firmly bonded to asbestos felt which, in turn, is applied to steel core sheet with asphalt. On exposure, copper surface gradually darkens to deep brown and along seaboard acquires characteristic green patina. May be painted to give any desired color effect, flat paint only being necessary. Furnished in sheets 30 and 50 in. wide, weighing 1½ oz. per square foot and in sheets 30 in. wide weighing from 2 to 8 oz. per square foot. No limitation as to length.—H. H. Robertson Co., Grant Bldg., Pittsburgh, Pa.



MOTOR-DRIVEN GRAB BUCKET *(right)* for use in handling of bulk materials powered by Westinghouse d.c. control makes possible use of only two conductors between control cab and bucket. Since each bucket carries its own motor it may be attached to crane, monorail hoist or any other hoisting equipment where electric power is available by slipping hoisting-block into holding yoke and plugging in for electrical connection. Other advantages: Attached or detached in a minute; bucket works within own height; digs itself in without being dropped; whole or part of load maybe dug or emptied; automatic devices protect mechanism. Capacities ½ to 3 cu.yd. —Erie Steel Construction Co., Erie, Pa.

ALUMINUM WEIGHT-HUNG WINDOW *(below)* for residential use has sash frame and weights built into one unit and is glazed and ready for quick installation. Mullions between double hung windows reduced from approximately 5½ to 1 in., and these, with narrow sash members and frames permit maximum of daylight to enter structure. Advantages: Shrinking, swelling, warping, rattling and rusting eliminated; small maintenance expense; easily operated; snug fit keeps out snow, rain wind and dust.—The Kawneer Co., Niles, Mich.

POWER EXCAVATOR *(left)*, of 1¾ cu.yd. capacity, and convertible to shovel, dragline, clamshell or crane uses. Supplied either with wire rope or chain crowd. Boom angle may be changed without adjustment other than necessary raising or lowering of boom by power boom hoist. All levers and foot pedals conveniently located. Main hoist and auxiliary clutches set by power. Machinery distributed on revolving platform with view to proper balance and to lifting stated loads with least possible amount of counterweight. Available with gasoline or diesel engines, or single electric motor drive. Protection for operator and full view of his work afforded by construction of steel cab which is cut back on opposite side to assure clear vision and by glass windows in steel frames.—The Osgood Co., Marion, Ohio.

for Bigger Yardages Quicker

LE TOURNEAU EQUIPMENT

In gumbo, on levees East or West, at Bonnieville Dam, on grades adverse or favorable — everywhere . . . jobs prove that Le Tourneau Equipment can and does handle more dirt, handles it more quickly, and consequently more cheaply.

These Carryall Scrapers make 9 trips an hour, working dirt, clay and decomposed rock, over grades 38 to 40% favorable to haul on a 1600-foot round trip —72 cu.yds. per hour on a million-yard highway contract in California. (Left)

Le Tourneau Super Carryall Scrapers are double purpose units—loaded by draglines, working as a wagon on a Sacramento River levee in California. (Above)

A 4200-foot round trip over sticky, clinging gumbo, yet the Le Tourneau Buggy hauls a capacity load every 18.1 minutes—4.2 minutes to load with 1¼-yard shovel, 7.7 minutes to haul loaded, 6.1 minutes to return. Airwheels keep the big loads on top for Brooks-Calloway Company — Mississippi River Levee. (Below)

Le Tourneau Buggies are easily loaded, dump quickly—in a fraction of a minute. This one made 37 trips in 9 hours on a 1650-foot round trip haul, including 150-foot ramp of 10% grade, placing 925 cu. yds. That's keeping old Man River in his bed.' (Right)

Now a Truck Buggy—for use at Bonnieville Dam, where big yardages and speed are demanded in the contractors' race with the Columbia River. Capacity, 35 cu.yds. water level; 45 yards loose measure . . . mounted on sixteen 13.50 x 20 tires. Truck drive especially designed by LeTourneau and mounted on eight similar-sized tires. (Left)

Our Engineering Department is constantly conducting detailed, on-the-job time studies of Le Tourneau-equipped jobs. The data so obtained is available for your use. Write us, describing your dirt-moving problems . . . we will gladly send you data sheets telling how LeTourneau equipment has licked similar jobs for other contractors.

Ask for
DATA SHEET PROOF

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TOUGH JOBS?... This tire likes 'em

This heavy duty Goodyear Dump Truck Tire is built for the tough jobs—for excavation work—for off-the-road service—for heavy construction hauling—for the kind of work your trucks do.

It has that famous gripping All-Weather tread for maximum traction. It has an extension of that tread down the side walls for traction in ruts, for protection of shoulders and side walls against cutting and scraping over sharp rocks and rough surfaces. To provide strength for the hard pulls and heavy loads, it has a Supertwist cord body with special chemically-toughened rubber. And to withstand the strains caused by heavy swaying loads on rough ground it has Goodyear's new patented extra strong bead construction.

Put this tire on your heavy-hauling construction trucks. Give it the tough jobs. Find out what tire performance really is. You'll find, too, it's a **MONEY SAVER.**

THE GOODYEAR TIRE & RUBBER CO., INC., AKRON, OHIO

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He is the Goodyear Truck Tire Man. He represents the most complete line of truck tires made. Behind him are all the years of Goodyear experience in the design and application of truck tires for every type of business—for every job. He can pick the tires for your trucks that will do your job better—will give you better service, longer service, more economical service. Ask your Goodyear dealer to send him over. It costs you nothing. He'll save you money.

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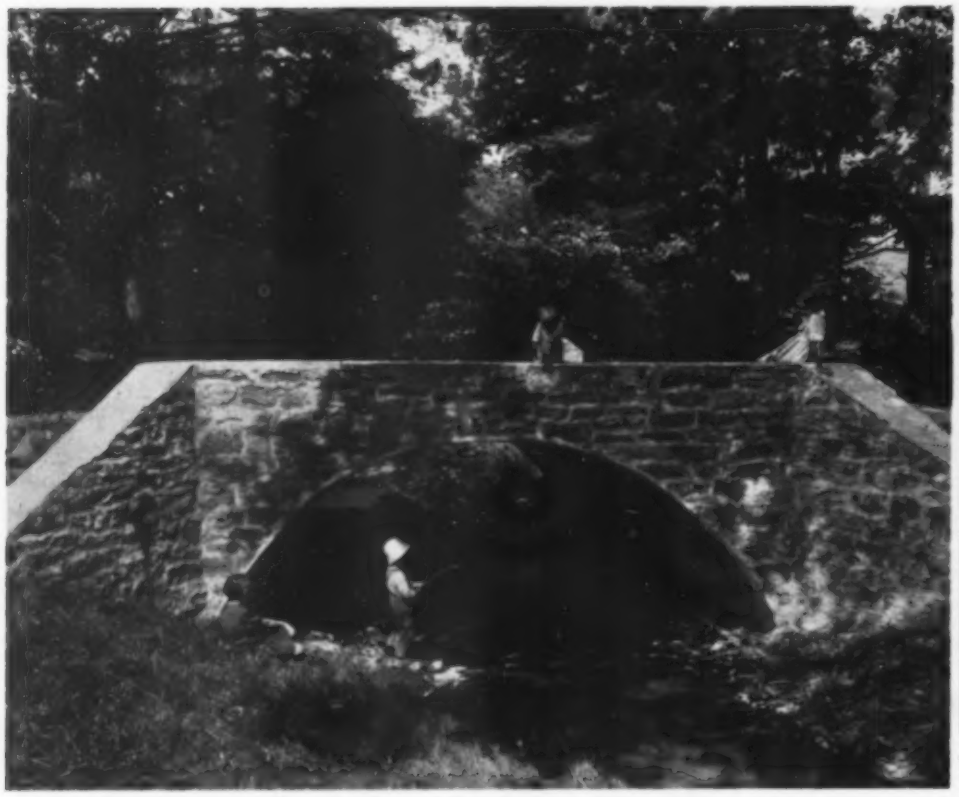
You Can Build *Attractive* Small Bridges

With MULTI PLATE and Stone



ARMCO'S "BALANCED DRAINAGE" PLAN	
FOR MAIN ROADS (State Highways and Important County Routes)	
Type of Installation	**Product Recommended for Best Results**
1 Small and medium size openings. (8 to 84 in.)	
a. Entrance Drains	Armco Corrugated Pipe
b. Cross Drains	Armco Paved Invert Pipe
2 Bridges and Large Culverts	Armco MULTI PLATE (Full-round or arches)
3 Subdrains	
a. Paralleling Road	Armco Perforated Pipe
b. Under Pavement	Armco Perforated Pipe (with Paved Invert)
FOR SECONDARY ROADS (County and Township Roads)	
Type of Installation	**Product Recommended for Best Results**
1 Small and medium size openings	
a. Normal Conditions	Armco Corrugated Pipe
b. For Steep Grades	Armco Paved Invert Pipe
c. Continuous Flow	Armco Paved Invert Pipe
d. Under High Fills	Armco Paved Invert Pipe
e. Diameters larger than 24 inches	Armco Paved Invert Pipe
2 Bridges and Large Drains	Armco MULTI PLATE (Full-round or arches)
3 Subdrains	Armco Perforated Pipe

This attractive but economical Armco MULTI PLATE bridge is located in Pennsylvania.

TODAY, considerable attention is being given to making our roads and roadsides more attractive. Naturally, the drainage structures should harmonize with the surroundings—especially those located where people can see them.

This problem has been economically solved by the use of Armco MULTI PLATE in pipe or arch design. Made of thick, deeply-corrugated and rust-resisting Ingot Iron plates, Armco MULTI PLATE has ample strength and durability.

Erection is simple. An arch, for example, can be erected on ordinary footings in a day's time or less. And the earth backfill is made directly against the metal arch which of itself carries the entire load. Headwalls of native stone can be built to suit the individual taste, but they need not be expensive.

Mail the coupon for a free copy of our booklet on Armco MULTI PLATE.

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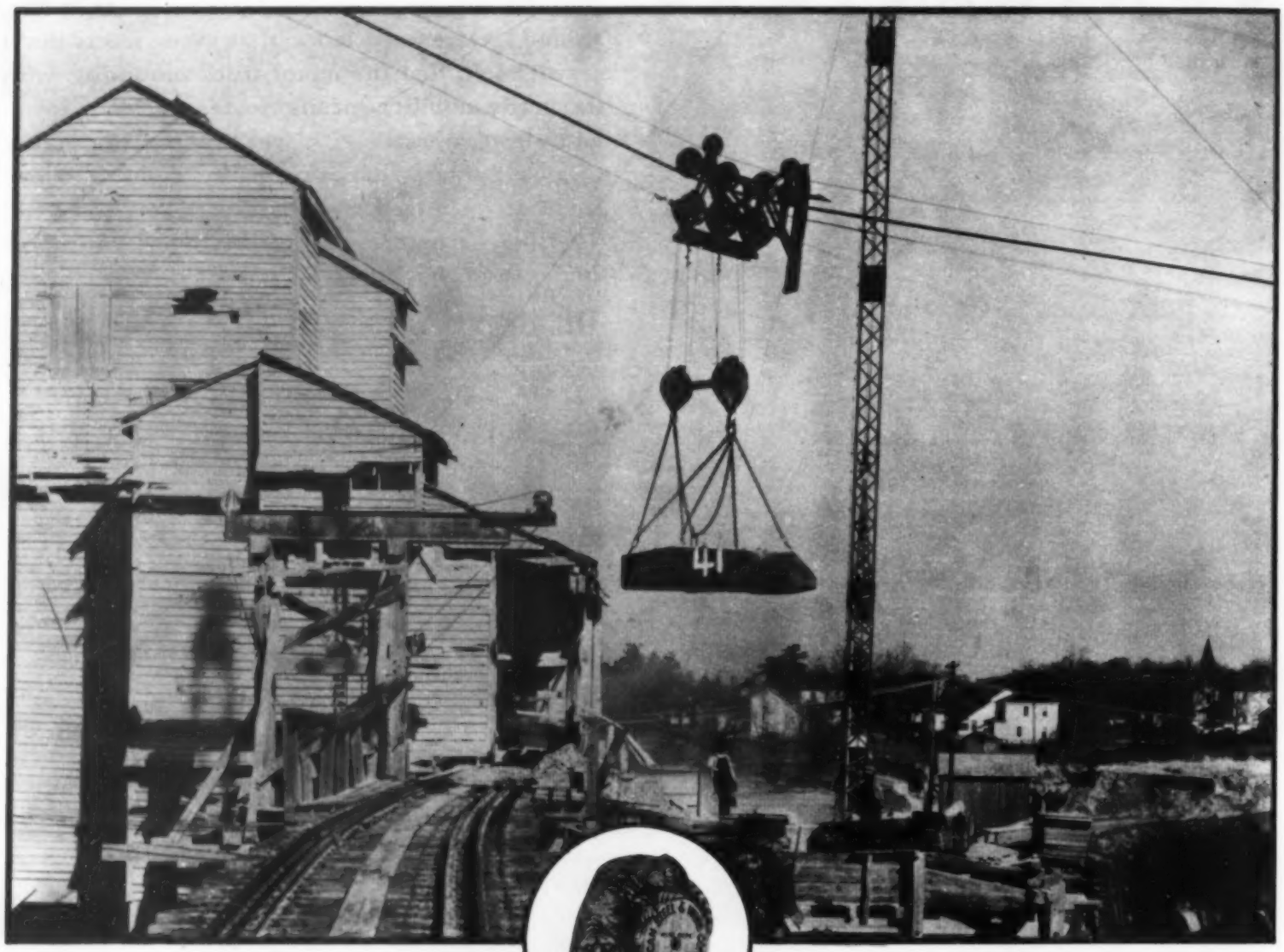
"CRAWLER-MINDED" CONTRACTORS

● Have you ever considered the profit-making possibilities of a Universal Truck Shovel or Crane on your job? Crawlers are much more popular, we know, for we build a complete line of quality ¾-⅜ yd. crawler units; but Universal also knows, from 17 years' experience, that every job is not a crawler job; that the motor truck mounting, with its speedy mobility, means greater efficiency, lower costs, faster operations, bigger profits on hundreds of jobs. You may have one of these jobs on which these new Center Drive units, as ¾-⅜ yd. shovels, as 6½-8 ½ ton cranes, are just what you need. *Better write for a bulletin, today, and investigate.*

THE UNIVERSAL CRANE CO. • LORAIN, OHIO

UNIVERSAL LORAIN

IN PIT—IN AIR
—ON SURFACE—



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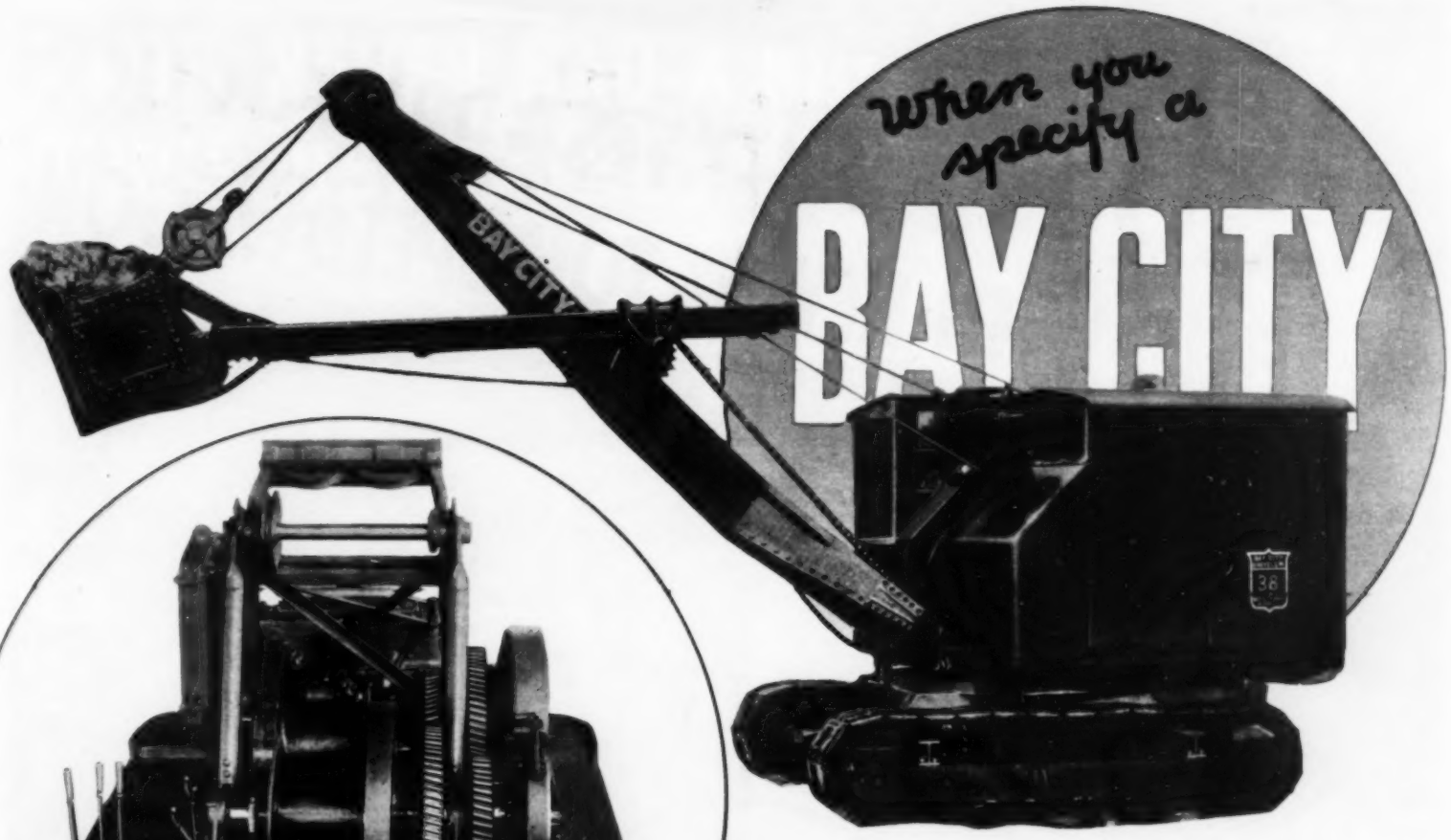
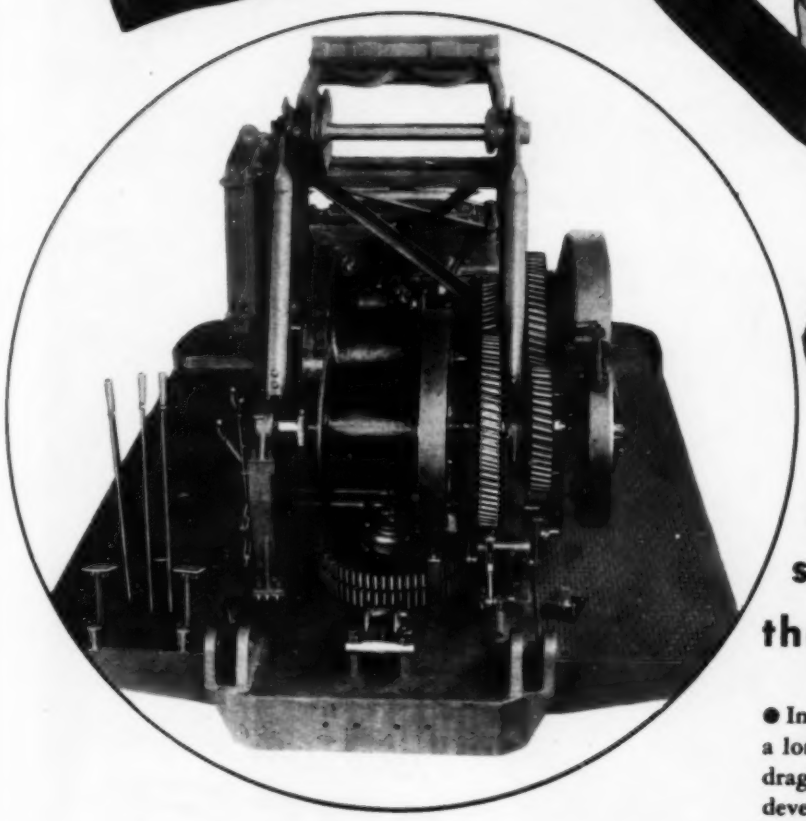
Offices in All Principal Cities

United States Steel Corporation Subsidiary





for your NEXT Shovel, you will secure these outstanding advantages that mean MORE YARDAGE...

● In days of close competitive bidding, *more yardage* at less cost means a longer profit to the contractor. Bay City Shovels, convertible to crane, dragline, trench-hoe or skimmer, incorporate the best construction features developed during the past 20 years. Standardized Bay City design avoids surplus weight thru proper balance and special analysis heat-treated steels.

Sturdy, tough and dependable, yet never extreme, Bay City design offers economy of operation and upkeep. Note for instance, the machinery assembly illustrated at the left. Tandem drums with more cable surface permits straight cable lead from drums with any boom or bucket, thus avoiding undue cable wear without off-center pull. Helical cut alloy steel gears insure quiet, smooth operation and longer life. This efficient machinery arrangement and design is standard on all Bay City full-revolving models.

Before you buy your next shovel, compare Bay City construction materials, design, accessibility, speed, working ranges and safe load capacity with any machine in the same capacity or weight class. You can't beat Bay City value regardless of what you pay.

25 REASONS for CHOOSING a BAY CITY Model 38

1—Convenient economical weight.
2—Helical cut gears—noiseless, long wearing.
3—Unit (nickel-manganese) car body and machinery table, totally heat treated.
4—Frictionless bearings thruout.
5—6 cylinder power.
6—Extra large diameter swing roller-path.
7—Oversized clutches and brakes.
8—Drop forged crawler shoes.
9—Long crawlers—low bearing pressure.
10—Chain crowd with automatic adjustment.
11—Swing lock—in any cab position.
12—Automatic Travel lock.
13—Extra heavy cab. Plenty inside working room.
14—Fast operating speeds.
15—Two travel speeds.
16—All steel construction.
17—Three lever control.
18—E-Z clutch control.
19—High pressure lubrication thruout.
20—Safety worm boom hoist.
21—Separate hoist drums.
22—Internal swing teeth.
23—Unequalled steering at full speed.
24—Convertible—without machinery change.
25—Accessibility for inspection or adjustment.

AVAILABLE IN 9 SIZES— ⅜ TO 1¼ CU. YDS.

Model	Designation	Shovel Weight	Crane Capacity
Tractor	⅜ yd. (¾ Circle)	20,500	3 ton
27	Heavy Duty ⅜ yard	27,800	5 ton
30	Standard ½ yard	30,800	6 ton
38	Heavy Duty ½ yard	38,000	7½ ton
42	Standard ¾ yard	41,000	10 ton
52	Heavy Duty ¾ yard	52,400	12½ ton
62	Heavy Duty 1 yard	64,000	17½ ton
52-Special	1 yard	56,000	15 ton
62-Special	1¼ yard	67,000	18 ton

BAY CITY SHOVELS Inc. (Eastern Offices, Roselle Park, N. J.) **BAY CITY, MICH.**

REO ENTERS LOWEST-PRICE TRUCK FIELD WITH NEW 1½ TON SPEEDWAGON

● Here's live, vital news for thousands of truck buyers who have always wanted Reo Speedwagon performance, power, speed and stamina—but who have heretofore been unable to pay Reo quality prices:

A brilliant new Reo 1½ Ton Speedwagon powered with the new Reo-built Silver Crown truck engine and featuring maximum loading space, streamline appearance and hydraulic brakes—at the amazingly low price of $535.

Now Reo truck quality and enduring value are within reach of all. For only a few dollars more than the cost of the lowest priced truck, you get typical Reo long life, extra service and satisfaction. More important still, you get a definite Reo PERFORMANCE GUARANTEE which assures you of satisfaction in advance of the purchase.

Reo's great new Silver Crown truck engine is especially designed by Reo engineers for fast, economical transportation of goods. Lo-Ex pistons, valve seat inserts and a score of other superb features contribute to a wide range and regularity of service that formerly called for a much higher investment.

Built for discriminating buyers who insist on quality, but must also consider price, the new Reo Speedwagon merits your immediate consideration. There is a wide range of Reo-built body-styles matched to the Reo chassis to provide a complete, coordinated Reo-built unit. You can depend on this sturdy Reo truck to do your job at lowest cost.

POWERED WITH THE SENSATIONAL NEW 6 CYL. SILVER CROWN ENGINE

REO-DESIGNED—REO-BUILT

Reo Speedwagons and Trucks range from ½ to 4-6 tons including Tractor-Trailers and Buses. Prices from $495 up, chassis f.o.b. Lansing, plus tax. Special equipment extra.

Prices subject to change without notice.

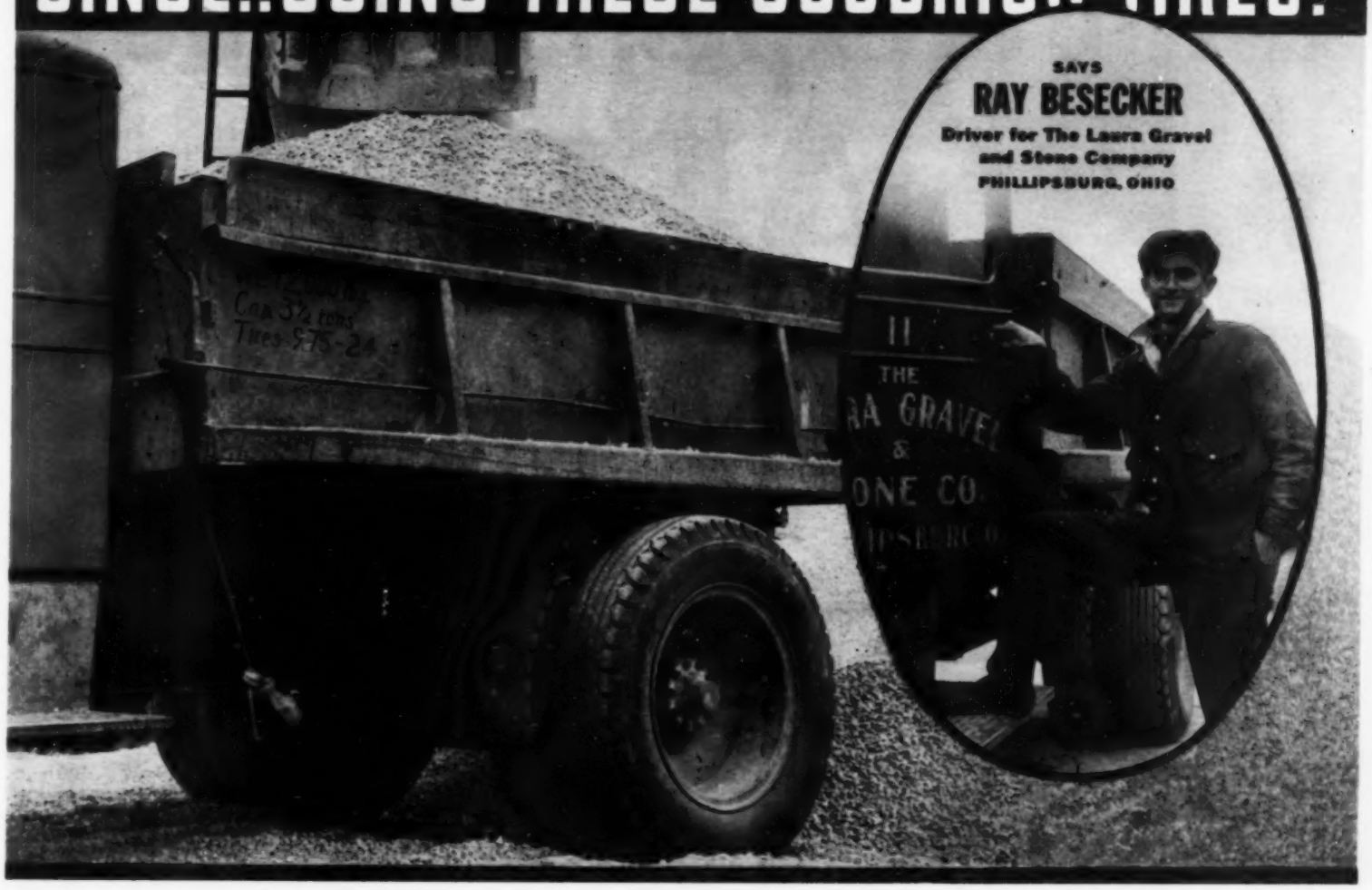
REO

MOTOR CAR COMPANY

LANSING, MICHIGAN

STANDARD BODY TYPES FOR NEARLY EVERY HAULING NEED

"HAVE NEVER HAD A SIDEWALL FAILURE SINCE..USING THESE GOODRICH TIRES."



What does a truck driver think about tires? Well, listen to what Ray Besecker, driver for The Laura Gravel and Stone Company, says:

"For 15 years I've been driving trucks and I've never seen tires that stand up like these new Silvertowns. I haul eight-ton loads of stone over all kinds of roads and have never had a sidewall failure since we have been using these Goodrich Tires. "I hate to make tire changes on the road—that's why I like Silvertowns."

There are no soft jobs at this plant —for men or for tires. Those big trucks bang their way over crushed rock, bounce over rough dirt roads and then hit it up on the highway. Just the sort of job where you would expect plenty of sidewall failures.

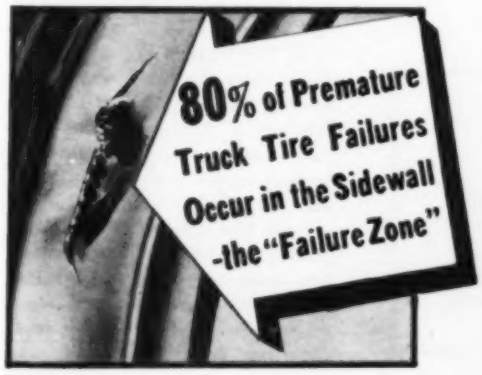
But not with Triple Protected Silvertowns! Every tire has a 3-way safeguard—designed to give positive protection against these money-eating failures. Look at this:

1 **PLYFLEX**—a *new*, tough, sturdy rubber material with greater resistance to stretch. A layer of Plyflex in the sidewall prevents ply separation—distributes stresses—checks local weakness.

2 **PLY-LOCK**—the new Goodrich way of *locking* the plies about the bead. Anchoring them in place. Positive protection against the short plies tearing loose above the bead.

3 **100% FULL-FLOATING CORD**—Each cord is surrounded by rubber. With ordinary cross-woven fabric, when the cords touch each other, they rub —get hot—break. In Silvertowns, there are no cross cords. No friction.

You pay no more to get Triple Protection—the invention that checks 80% of premature failures.



FREE! 44-PAGE HANDBOOK FOR TRUCK OPERATORS

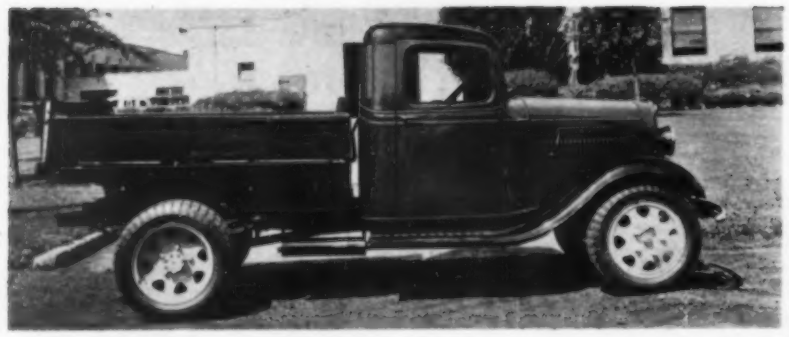
Every truck owner, every driver should have this big 44-page data book. Gives commodity weights, load schedules, inflation schedule, dual spacings and other useful information. No obligation. Write for free copy. Department T-33, The B. F. Goodrich Company, Akron, Ohio.

Goodrich *Triple Protected* Silvertowns

SPECIFY THESE NEW SILVERTOWN TIRES FOR TRUCKS AND BUSES

THE TRUCK GMC OF VALUE

You'd expect it to be SAFER



. . . IT IS ! . . .

LOCKHEED HYDRAULIC BRAKES

plus centrifuse brake drums and exceptionally large lining area assure full protection

IN JUDGING the value of 1½-2 ton trucks, seasoned operators are giving particular heed to safety factors. That's why so many of them are swinging to the quality GMC, the many-feature truck that returns to owners far more in work done and profits earned.

In addition to more than two score of other important dollar-saving quality features, the 1½-2 ton GMC has a brake factor combination unmatched by any competitive truck. Its self-equalized Lockheed hydraulic brakes are of the latest type—extremely powerful, positive and rugged. Brake drums are of the economical centrifuse type—non-scoring, non-warping. Brake linings are of exceptionally high quality and unusually large area—long-lived and economical.

Comparison—part by part—will quickly prove to any truck buyer why the many-feature GMC is worth every penny of its price . . . will prove that this truck excels each of its chief competitors on many counts, that it has, in fact, a combination of 47 important money-saving features that you will find in no other truck of like capacity.

See, test and compare for yourself this quality GMC that out-performs and out-earns. Or if your needs call for trucks or trailers of greater capacity, see the balance of the GMC truck and trailer line. Capacities range from 1½ to 22 tons.

Revolutionary Dual-Performance Axle in 2-3 ton GMC

This new advanced truck feature provides a high-high gear (5.14 to 1) for fast movement on the level at economical engine speed and a low-high gear (7.15 to 1) which assures improved performance with heavy loads on hills or where the going is hard.

A TYPICAL VALUE FACT

Included in the 47 important GMC quality features is full pressure lubrication. This means that oil is forced under pressure to all main, connecting rod and camshaft bearings, as well as to the piston pins through rifle-drilled connecting rods. Such a complete system of lubrication is naturally more costly to install but it is the truck owner's assurance of protection against premature wear and costly upkeep expense.

GENERAL MOTORS TRUCKS & TRAILERS

1½-22 TONS

GENERAL MOTORS TRUCK CO. Time Payments Available Through Our Own Y. M. A. C. PONTIAC, MICHIGAN

FOR BEST RESULTS USE TAR

1. FOR PRIME

A proper prime coat has three characteristics: (1) Ability to penetrate properly; (2) Ability to bind the aggregate; (3) Ability to retain its binding properties and not weather out or emulsify.

TAR HAS THESE INHERENT CHARACTERISTICS—Tar has proven, without question, its superiority as a primer. Other types of prime have been experimented with in the past, but in practically all such cases officials have gone back to specifying tar only.

In the past, only light tar (TC-1) was used for priming purposes, but modern practice has shown that viscosity of primes should vary according to surface texture and road surface temperature.

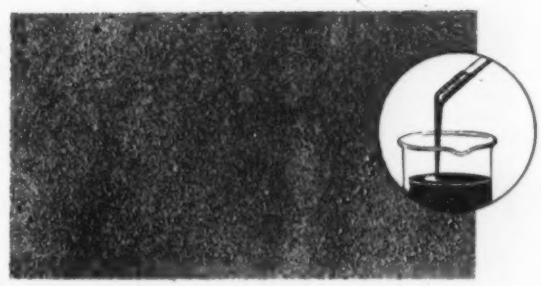
Light grades on open surfaces may penetrate to a greater depth than is necessary; the depth of penetration can be regulated by the viscosity of tar used—light grades on dense tight surfaces, heavier grades on the more open surfaces. High atmospheric and road surface temperatures increase depth of penetration and vice versa.

Recommended procedures are given under the photos on this page. For best results use the heaviest grade of tar applicable in each instance.

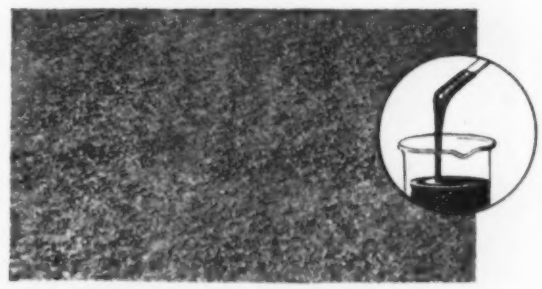
(In the cool months of spring and fall, it is often advisable to use tar prime one or two grades lighter than used during warm months).

CONSISTENCY OF COLD APPLICATION TARS
(and proposed Standard Designations)

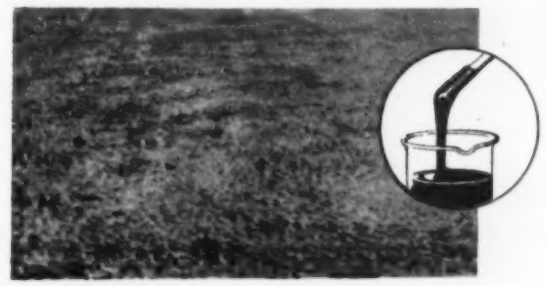
Proposed Standard Designations	Corresponding Tarmac Designation	Consistency Spec.-Viscosity-Engler. 50 cc @ 40° C.	50 cc @ 50° C.	Application Temperatures
TC-1	P-1	8-13		60-150° F.
TC-2	P-2	13-18		60-150°
TC-3	P-3	18-25		80-150°
TC-4	P-4	25-35		80-150°
TM-1	P-5		16-22	80-150°
TM-2	P-6		26-36	80-150°



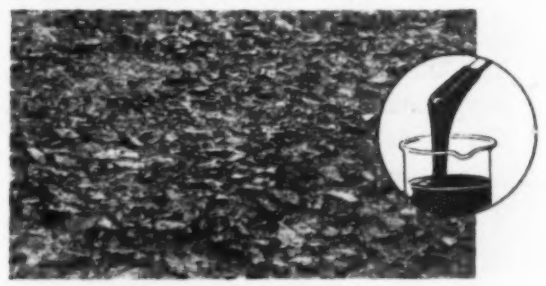
For tight bases, such as limerock, closely bound sand clay, or stabilized gravel..... **TC-1 or 2**



For average bases, such as top-soil, clay-gravel, granular sand clay, traffic bound macadam, waterbound macadam..... **TC-2 or 3**

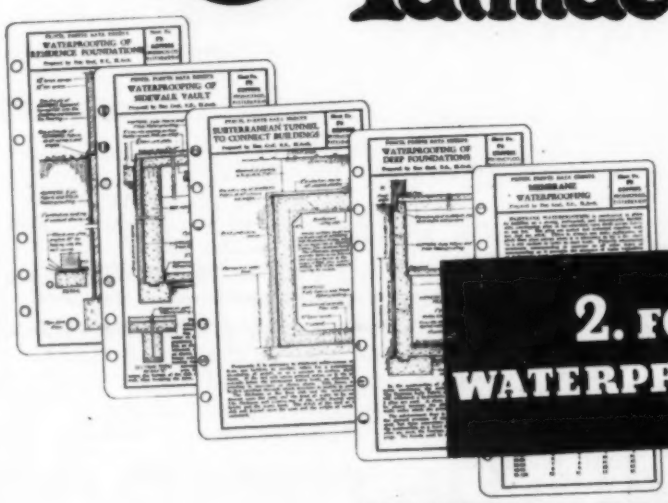


For fairly open bases, such as some sand-clay, gravel or sandstone..... **TC-3 or 4**



For open bases, such as native stone hand-knapped and loosely bound, or loosely bound macadam..... **TM-1 or 2**
(Base in this picture already primed).

KOPPERS **Tarmac**



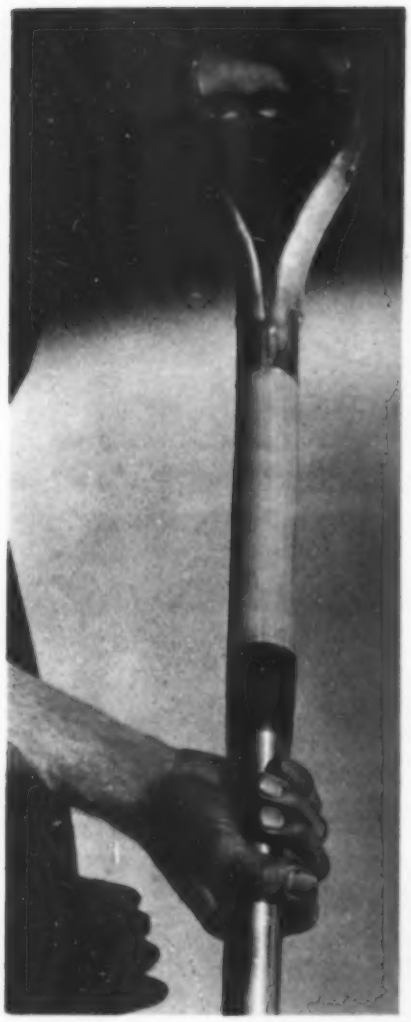
2. FOR WATERPROOFING

Almost any concrete or masonry structure which is not effectively waterproofed will show the destructive effect of water, to some degree. Tar is one material which can stand contact with water without deterioration. A complete study of the subject of waterproofing and dampproofing has been made by the Koppers Products Company. Send for the Sweet's Reprint and the Don Graf Data Sheets covering this subject. They will be sent to you without charge.

We will be glad to help you work out any problem of waterproofing tunnels, bridges, foundations, etc.

KOPPERS PRODUCTS COMPANY
KOPPERS BUILDING - - PITTSBURGH, PENNSYLVANIA

Other Koppers Products: Roofing, Creosote, Tar Paints, Traffic Paints



MORE ABW SHOVELS ARE SOLD THAN ANY OTHER MAKE

WHY?

BECAUSE—for 161 years, ever since John Ames set up his hand-forge in Massachusetts in 1774, we have been making shovels.

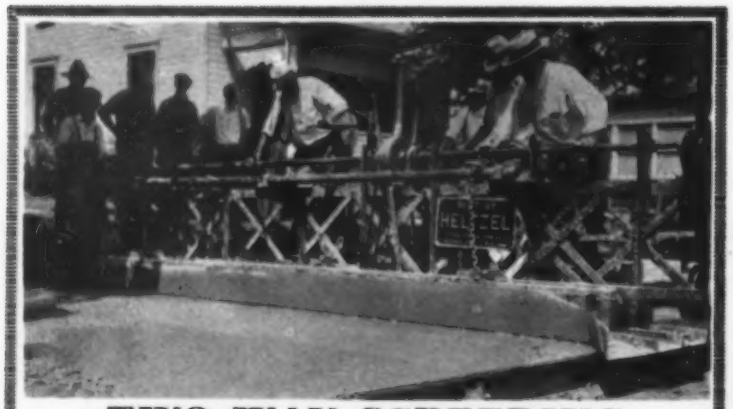
We have adopted every scientific improvement in treating steel every new device and machine for making our shovels stronger, lighter and of a greater merchandising value.

FOR EXAMPLE—all our Solid Shank shovels are now armored at the "danger line," where the prying strain comes, with the new Patented ABW Shock Band. This increases the handle strength about 21%. No other shovel can have it. It costs you no more. One of the many reasons why

MORE ABW SHOVELS ARE SOLD
THAN ANY OTHER MAKE

AMES BALDWIN WYOMING CO.

North Easton, Mass. Parkersburg, W. Va.



TWO WAY SCREEDING

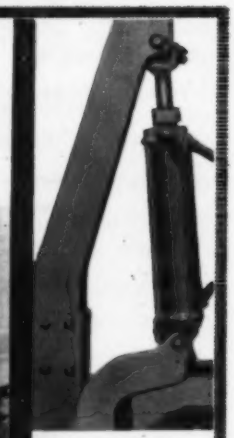
It is no longer necessary for pitmen to carry concrete back to fill in low places. The FLEX-PLANE screed will do it for you. The screed is raised slightly at intervals, leaving excess material in windrows, which is again carried forward when the machine is reversed.

FLEX-PLANE screeding machines are complete in every detail and are suitable for all types or roads. They are flexible and allow the contractor to perform many operations otherwise impossible with one machine.

For screeding black top a special screed is furnished, having strike-off plates in front for striking off the binder course, also dolleys, which allow for the proper amount of compaction by rollers.

FLEXIBLE ROAD JOINT MACHINE CO.
Warren, Ohio

BAKER BULLDOZERS



DIRECT LIFT

No Loose Joints
No Gears to Wear

A good tractor deserves a good Bulldozer. Users of Baker Direct-Lift, Hydraulic Bulldozers say they are so simply constructed that they have almost no delays for repairs or replacements. This, coupled with their accurate control and great strength is the reason for more Bakers on more jobs.

OTHER BAKER PRODUCTS

GRADEBUILDERS
ROAD ROOTERS
ROAD DISCS
MANEY SCRAPERS
ROTARY SCRAPERS
SNOW PLOWS

Write for Bulldozer Bulletins

THE BAKER MFG. CO.
568 Stanford Ave.
SPRINGFIELD, ILL.

Lift COLD-WEATHER HANDICAPS FROM CONCRETE CURING

CALCIUM CHLORIDE ASSOCIATION
THE DOW CHEMICAL COMPANY
Midland, Michigan
THE COLUMBIA ALKALI CORP.
Barberton, Ohio
MICHIGAN ALKALI COMPANY
60 E. 42nd St., New York City
SOLVAY SALES CORPORATION
61 Broadway, New York City

NO LONGER need concreting operations wait for warm weather. The results of innumerable researches and tests made during the past decade show conclusively that Calcium Chloride incorporated in the mix so controls the effect of low temperatures that early, economical and efficient concrete curing can be readily achieved in *any* season. Reports of investigations by the National Bureau of Standards, the Highway Research Board, the U. S. Bureau of Public Roads, the Highway Department of the District of Columbia, the Ohio State University, the Portland Cement Association, and various state organizations, all confirm the practical value of Calcium Chloride in all paving or structural concrete.

Such widely assembled data, supported by years of actual use in the field, give positive assurance that Calcium Chloride incorporated in standard Portland or high-early cement concrete mixes, effects these invaluable advantages:

1. *By accelerating the rate of hardening, concrete attains higher strength than is otherwise possible in low or changing temperatures.*
2. *Shortens by approximately one-third the safe opening-strength time at 40° to 50° F. Makes heating of materials seldom necessary and reduces the length of time expensive covering may be required.*
3. *Maintains a more constant moisture content and controls volume changes from the time the concrete is placed—resulting in greater density and uniformity.*
4. *Increases workability—permitting lower water-cement ratio mix design, thereby increasing durability and strength.*

Such benefits from the use of Calcium Chloride in concreting are inestimable. The contractor saves money in labor, equipment tie-ups and earlier job completion. The public obtains earlier use of highways. The construction season can be lengthened to a major degree—with utmost confidence as to anticipated results. WRITE for further literature, statistical information and evidence, addressing any of the Members of this Association.

CALCIUM CHLORIDE *for modern concrete curing*

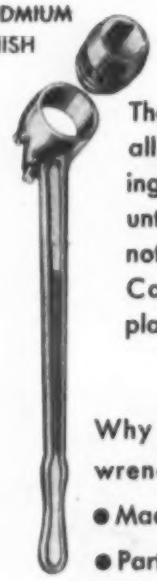
A STRONGER AND BETTER WRENCH IN EVERY WAY

THE NEW MODEL
of the
FAVORITE reversible ratchet WRENCH

No lost motion with the "FAVORITE"

Just the tool for saving money on the nut-turning portion of the contract.

CADMIUM FINISH



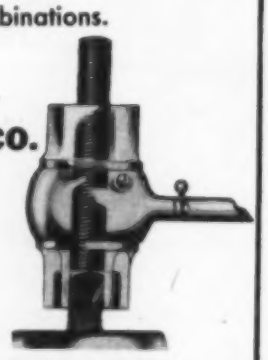
The ratchet movement cuts out all the lost motion of nut turning, because it stays on the nut until seated or removed. It is not forever slipping off the nut. Can be used in narrower places than an ordinary wrench.

Why the "Favorite" is a better wrench than it was:

- Made of stronger metal.
- Parts reinforced.
- More accurate nut fit.
- Sizes regrouped to avoid duplications and awkward combinations.

Send for full particulars.

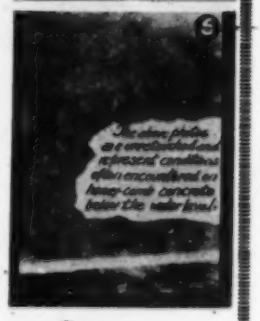
GREENE, TWEED & CO.
Sole Manufacturers
109 Duane St.
New York



Opening in head allows bolt to pass clear through.

WATER-PROOFING *with* Sika

1. Original surface hacked.
2. Water concentrated to enlarged bleeder holes by Sika #4A.
3. Two bleeder holes plugged by Sika #2. Infiltrations concentrated to bleeders.
4. Inserting Sika #2 into last bleeder hole.
5. All bleeder holes plugged with Sika #2, and trimmed to contour.
6. Protective coat of Sika #1 cement plaster applied.



Use Sika
to stop water inflow through any masonry. Sika mixed with portland cement easily applied by hand — seals off infiltration from underground streams even under pressure.

Write us about your problems

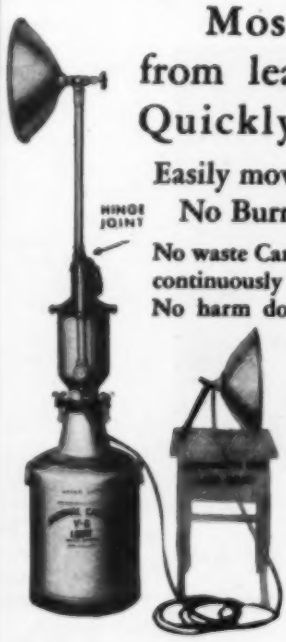
Sika, Inc.
1943 Grand Central Terminal
New York City

NATIONAL CARBIDE
V-G LIGHTS

Most Light
from least Carbide
Quickly Charged

Easily moved—No wires
No Burner Troubles

No waste Carbide whether used continuously or intermittently
No harm done if tipped over



Extension to X-100 DOUBLES THE CANDLE POWER *fastens anywhere*

Always use NATIONAL CARBIDE *"In the Red Drum"* Distributors Coast to Coast

WRITE FOR COMPLETE INFORMATION

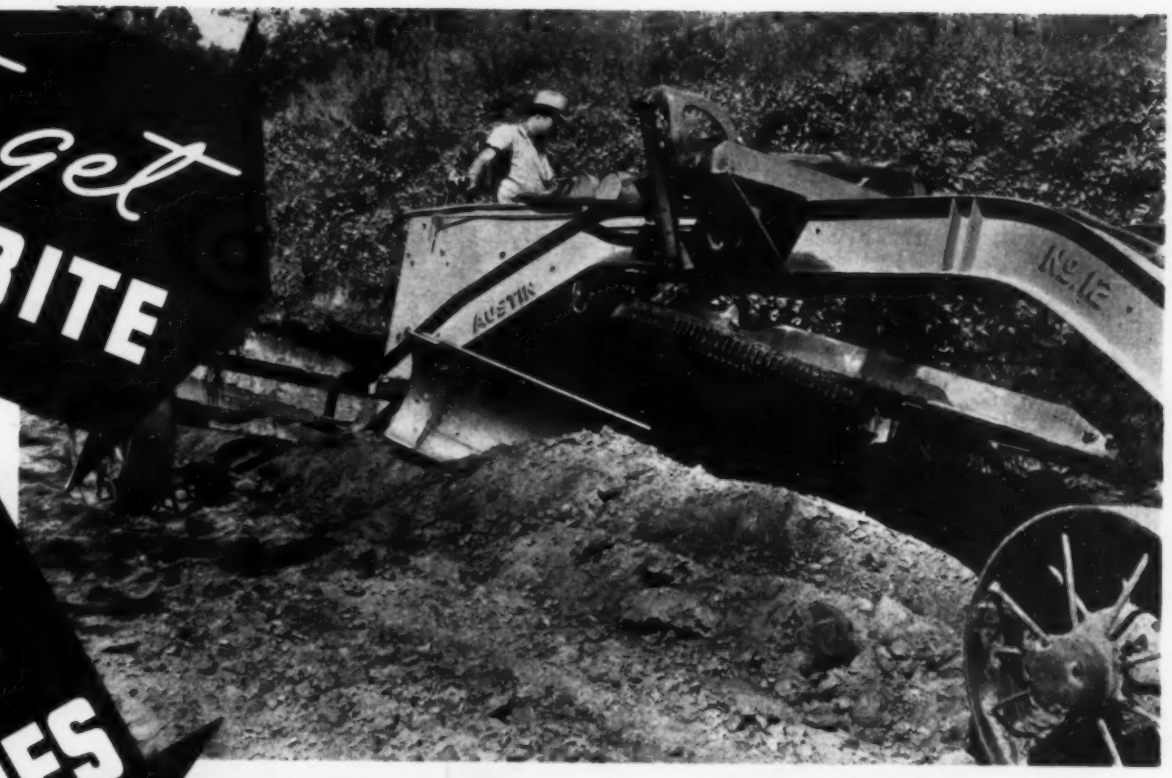
X-100
NATIONAL CARBIDE V-G LIGHT
About 8,000 c.p. for 12 hours on 7 lb. charge of National Carbide. Easily handled by one man. Weight 55 lbs. empty; 98 lbs. full.

Y199
NATIONAL CARBIDE V-G HANDY LIGHT
Burns about 5½ hours on 1¾ lbs. of 14-ND Carbide, 2 gals. water; delivers about 1500 c.p. Weighs 37 lbs. charged—easy to carry, handy in emergencies.

WL1-C1
NATIONAL CARBIDE LANTERN
Burns 8 hrs. on 8 oz. of Carbide. Brilliant rear signal of red, blue or green, no extra charge . . . Ideal for emergency lighting on road at night.

NATIONAL CARBIDE SALES CORP.
LINCOLN BUILDING
Opposite Grand Central, NEW YORK

To get THIS BITE



The "Bite" of the blade, as it smoothly rolls the earth along its carefully calculated curve, tells the whole story—tells the difference between an Austin-Western Grader and another.

these FEATURES

HEAVY BOX GIRDER FRAME
TAKES ALL STRAINS
DIRECT TRANSMITTAL OF DRAW BAR PULL
OVERSIZE CIRCLE
RESISTS UP THRUST
HOLDING THIS PLANE AND THIS LINE

ROAD GRADERS · MOTOR GRADERS · ELEVATING GRADERS · DRAGS

ROAD ROLLERS

Austin-Western

DUMP WAGONS

BITUMINOUS DISTRIBUTORS · ROAD-MIX MACHINES · CULVERTS
SCARIFIERS · BULLDOZERS · TRAILERS · SCRAPERS · PLOWS

DUMP CARS

CRUSHING AND WASHING PLANTS · SWEEPERS AND SPRINKLERS · SHOVELS · CRANES · ETC · SNOW PLOWS

The Austin-Western Road Machinery Co.
A-6, Aurora, Ill.

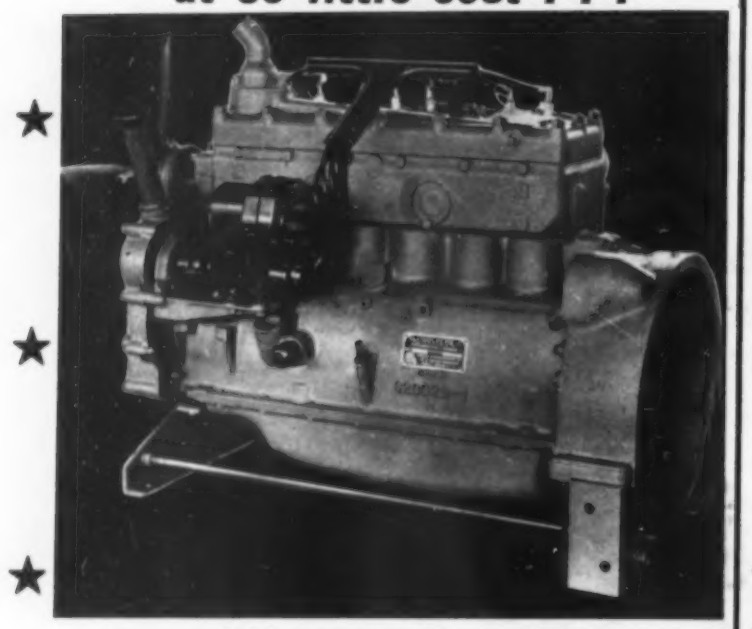
Send me complete information on the new ☐8', ☐10', ☐11', or ☐12' Austin-Western Grader

Name .....

Address .....

City ..... State 459

WHY
CHRYSLER
can give you so much engine at so little cost . . .



CHRYSLER builds a great engine" . . . that's a statement you'll hear from coast to coast.

Not everybody realizes, however, how little Chrysler engines cost . . . and why we can produce so much engine for so little money.

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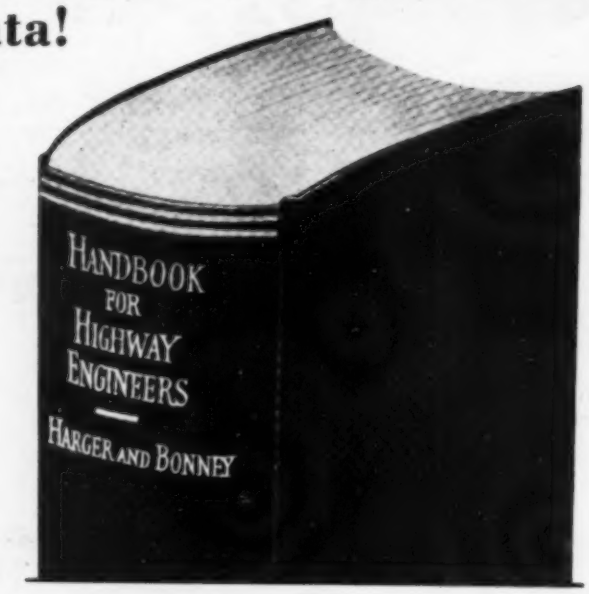

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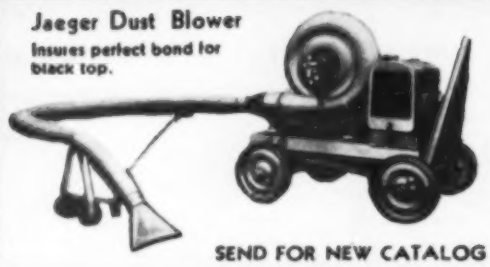

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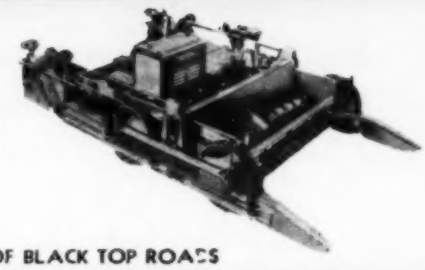

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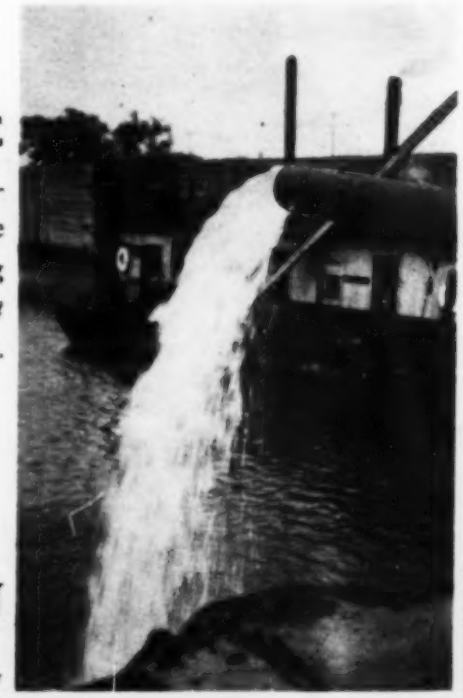

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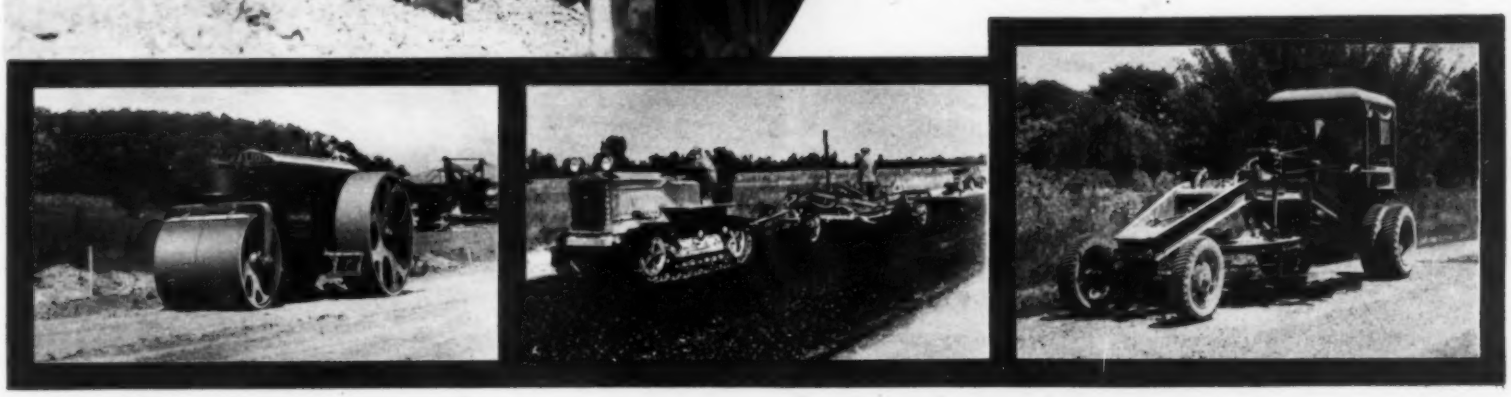

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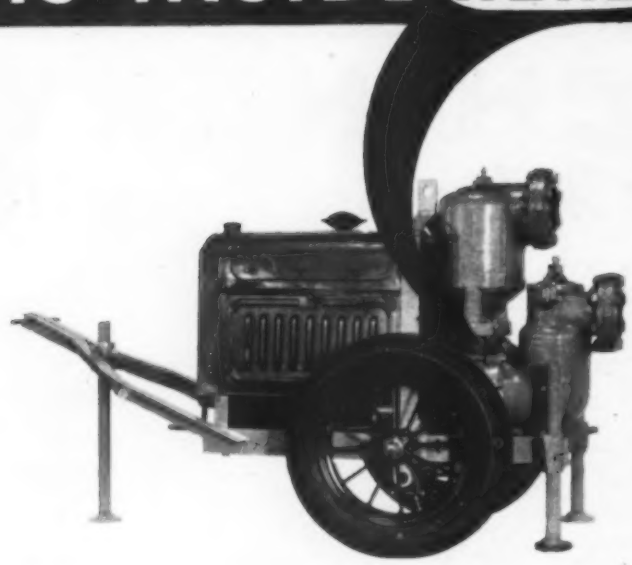

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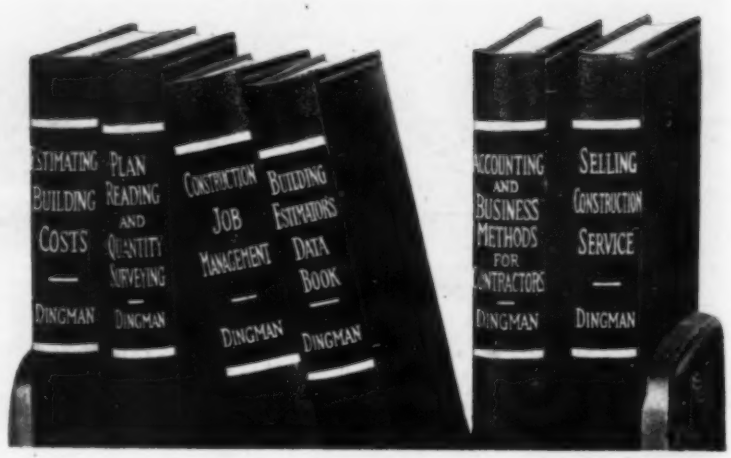

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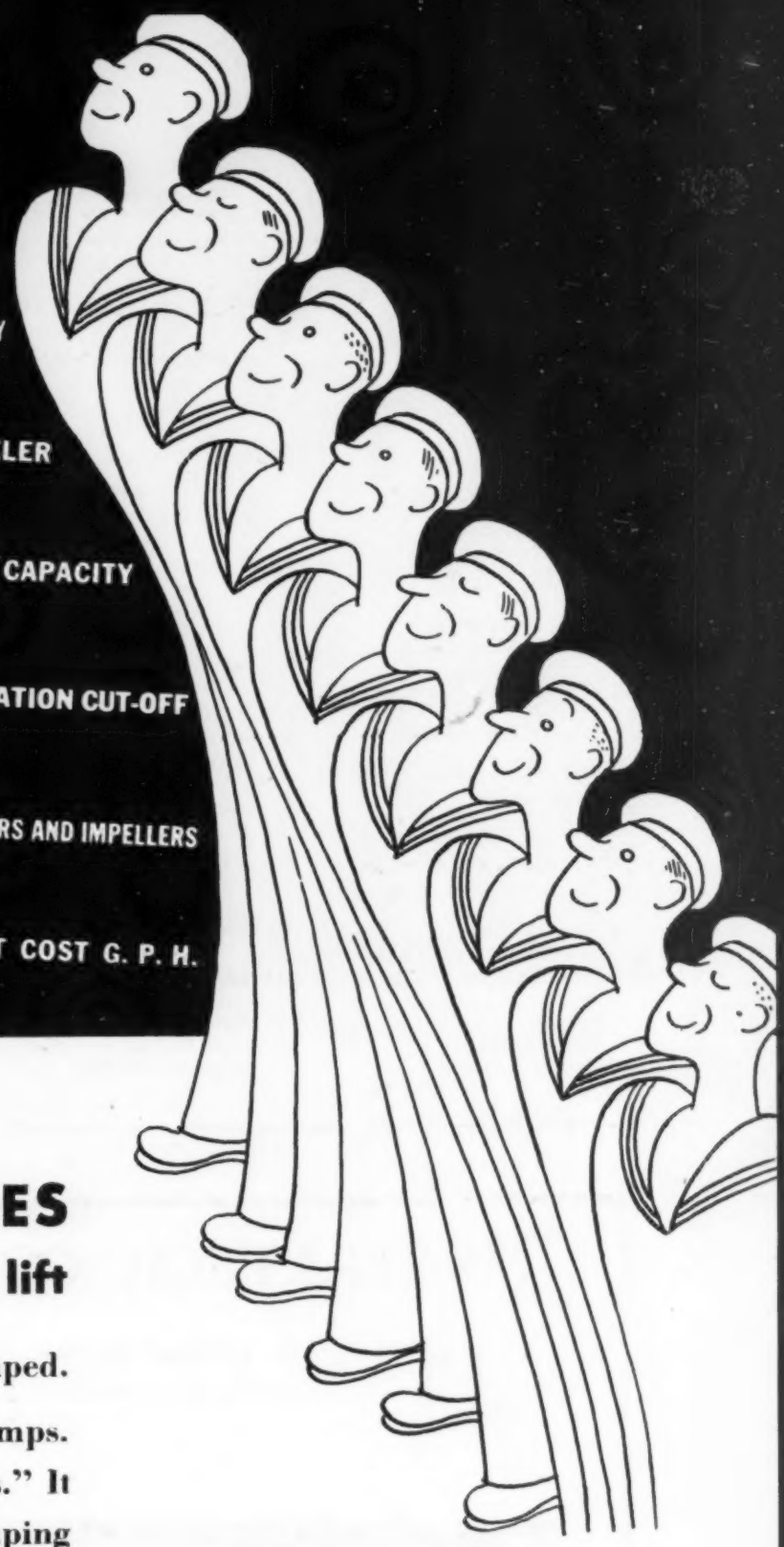

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